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ABSTRACT

Presented is a comprehensive survey of graduate and undergraduate programs in mathematics in effect during Winter and Spring of 1961. Questionnaires were mailed to 1,069 institutions which awarded degrees in mathematics or offered substantial programs in mathematics. Junior colleges and such specialized schools as Bible Colleges and seminaries, schools of art or music, law schools, and schools of business were not included. Data for the statistical analysis were taken from the 877 questionnaires which were returned. Information is reported on curricula, degrees, course offerings, enrollments, credit requirements, examination requirements, special features, innovations, and trends. The appendices provide specific information about graduate programs at individual institutions which were available in 1961. (RS)

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MATHEMATICS
IN COLLEGES & UNIVERSITIES

A COMPREHENSIVE SURVEY OF GRADUATE AND UNDERGRADUATE PROGRAMS (FINAL REPORT)

U. S. DEPARTMENT OF HEALTH, EDUCTION, AND WELFARE ··· Office of Education

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MATHEMATICS
IN COLLEGES & UNIVERSITIES

A COMPREHENSIVE SURVEY OF GRADUATE AND UNDERGRADUATE PROGRAMS (FINAL REPORT)

By
Clarence B. Lindquist
Specialist in Mathematics and Physical Sciences
Division of Educational Research

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Anthony J. Celebrezze, Secretary

Office of Education
Francis Keppel, Commissioner

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FOREWORD

In recent years there has been no discipline in which curriculum analysis and development have aroused greater interest and activity than in mathematics. Furthermore, mathematics and the mathematics-based fields of statistics and computing have been undergoing tremendous expansion in enrollments and degrees. Whereas 4,034 bachelor's degrees in the mathematical sciences were awarded in 1954-55 by U.S. colleges and universities, 14,610 were awarded in 1961-62. The Office of Education predicts that this number will increase to about 39,000 by 1969-70. By way of comparison, the corresponding data for all the physical sciences combined are 11,202 degrees for 1954-55; 17,040 for 1961-62; and 29,100 for 1969-70, figures which give ample evidence of the growing importance of mathematics.

The survey of mathematics programs reported here was the most comprehensive depth study of programs within a discipline ever undertaken in the United States. A total of 877 colleges and universities granting bachelor's or higher degrees, or about 82 percent of the 1,069 to which questionnaires were sent, responded. Both undergraduate and graduate programs were surveyed, and information was solicited on curriculums, degrees, course offerings, enrollments, credit requirements, examination requirements, special features, innovations, and trends.

This report is expected to be valuable not only to mathematics educators, but also to deans and others responsible for curriculum development in colleges and universities. In addition, the appendixes, which provide specific information about master's and doctor's programs at individual institutions, should be a helpful guide for prospective graduate mathematics students and their advisers.

The Office of Education wishes particularly to acknowledge for their advice and counsel Professor G. Baley Price of the University of Kansas, Professor Harry M. Gehman of the State University of New York at Buffalo (formerly University of Buffalo), Professor John W. Cell of the State College of the University of North Carolina at Raleigh, Professor Howard F. Fehr of Teachers College of Columbia University, and Dr. C. Russell Phelps of the National

Science Foundation. We express gratitude also to members of the Committee on the Undergraduate Program in Mathematics (CUPM) of the Mathematical Association of America for their helpful suggestions. Finally, we wish to express our appreciation to the hundreds of persons in colleges and universities who filled out the lengthy questionnaire and to the mathematicians who assisted in the conception of the survey and the questionnaire instrument.

RALPH C. M. FLYNT
Associate Commissioner for
Educational Research and
Development

FRANCIS A. J. IANNI, DIRECTOR
Division of Educational Research

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CHAPTER I. INTRODUCTION

Mathematics represents the highest level of abstract thought. To the mathematician, it is the essence of orderliness, form, beauty, and elegance. Like the musician and the painter, the mathematician obtains from his work an emotional and esthetic satisfaction. For this reason there is a considerable body of mathematicians who wish to be "pure mathematicians," that is, to study mathematics for its own sake, with no immediate concern for practical or useful results. Yet, history has proved that many discoveries made through pure study are later the basis for practical results.

Beyond its esthetic qualities, the utilitarian importance of mathematics is so great that only a country with a strong base in mathematics can produce the technology that places a nation among the leaders of the contemporary world. At present, when the United States and the Soviet Union are vying for world leadership in space and nuclear energy, the importance of mathematics to both nations is enormous. Accordingly, in the Soviet Union, mathematics is a major part of the general school curriculum. It takes up about one-sixth of the entire school curriculum and has traditionally been a required subject in the general education of all Soviet pupils in each grade. Although mathematics is equally essential to the defense, welfare, and prosperity of the United States, it receives less emphasis in the total school curriculum; it is not even a required subject in most senior high schools.

Traditionally, mathematics has been regarded as a necessary basic tool for physical science and engineering. More recently, the value of mathematics in the biological sciences, the social sciences, and business has been increasingly recognized. For example, the 1960 Annual Review of Physiology reported:[1]

> "In 1929, of 76 papers selected at random from the American Journal of Physiology, only 10.4 percent used mathematical equations of any sort, the most complex of which had four variables. In 1959, of 91 similar papers, 17.6 percent used equations, two with six and one with thirteen variables. Similar trends are to be seen everywhere in the literature."

Statistics and, particularly, computing, both heavily rooted in mathematics, are fields which have been undergoing tremendous expansion in recent years. For the computing field alone, an official of the Association for Computing Machinery recently estimated that 300,000 computer programers would be needed in the next 8- to 10-year period. Many of the positions will require college-level mathematics, and for some of the positions a degree in mathematics will be highly desirable.

In recent years, in terms of bachelor's degrees, mathematics has been the most rapidly growing discipline among the major fields of study. (See statistical data on mathematics degrees in the Foreword.) Concomitantly, there has been ferment in the mathematics curriculum at all levels. Many mathematicians feel that the traditional curriculum is outmoded and not in tune with newer ideas and emphases in mathematics. This feeling was already so strong in 1952 that the Mathematical Association of American established in that year a Committee on the Undergraduate program in Mathematics (CUPM). This Committee has been active since its inception in developing guidelines and recommendations for mathematics programs for (1) teacher training; (2) the physical sciences and engineering; (3) the biological, management, and social sciences; and (4) pregraduate training for graduate study in mathematics.

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[1] Published by Annual Reviews, Inc., and the American Physiological Society. Vol. 22, Preface, pg. v.

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RECENT MATHEMATICS CURRICULUM STUDIES

In 1959, CUPM authorized Frederick Mosteller, Keewhan Choi, and Joseph Sedransk at Harvard University to survey the availability of mathematics courses to undergraduates in the United States. [2] The survey was a catalog study of a stratified sample of institutions of higher education consisting of 216 four-year colleges and 54 junior colleges. The survey attempted to answer the following questions:

1. What mathematics courses were available to undergraduates throughout the United States?
2. What "modern" mathematics courses were available to undergraduates?
3. What elementary mathematics courses were available to undergraduates?
4. What were the mathematics prerequisites for enrollment in various physics courses?
5. What were the regional differences in the availability of mathematics courses to undergraduates?

A second study, carried out in 1961 under the sponsorship of CUPM and with financial support from the Ford Foundation, was reported in Undergraduate Mathematics Teaching: Settings and Staff, by Patricia Collette. [3] A sample of 135 baccalaureate-granting schools was studied, with primary emphasis on institutions which did not grant the Ph.D. in mathematics or statistics. The report contains information on certain characteristics of undergraduate mathematics curriculums.

In 1959, John A. Schumaker conducted a study of trends in the education of secondary school mathematics teachers for the period 1920-58.[4] His study involved 140 institutions throughout the United States that had programs for the preparation of secondary school mathematics teachers. The principal sources of data were the catalogs of the selected institutions. Schumaker's study reported the percentage of teacher-training institutions offering mathematics courses in selected years; the median minimum number of semester-hours required of prospective mathematics teachers in selected years; and the percentage of institutions requiring various specified mathematics courses of prospective teachers majoring in mathematics in selected years.

In the early 1960's, Lehi T. Smith sought data on curriculums for teacher-training through a questionnaire sent to the chairman of the mathematics department at 213 colleges and universities engaged in teacher-training. [5] His report gives data on the preparation of mathematics teachers for elementary and secondary schools; curriculums for teachers returning for graduate work; and the influence of curriculum-study groups on programs for teacher education.

PREPARATION OF THIS SURVEY

Pretest of the Questionnaire

A pretest of the questionnaire for the survey reported in this book was made in a sample of 90 institutions in May and June of 1960, and some modifications were then made: open-ended questions were replaced by items which were more objective and simpler to answer, in most cases, by a "yes" or "no."

Determination of the Universe

It was decided early in the planning stage that a universe rather than a sample study would be made of institutions offering bachelor's and higher degrees in mathematics. Junior colleges and such specialized schools as Bible colleges and seminaries, schools of art or music, law schools, and schools of business were eliminated from the start. The report on Earned Degrees Conferred, 1958-59, issued by the U.S. Office of Education, provided the list of most of the institutions to which questionnaires were to be sent. The remaining institutions, which were not in this list because they did not grant a bachelor's degree in mathematics in 1958-59 or because they were not yet in existence, were determined by examination of the Education Directory, 1960-61: Part 3, Higher Education, also a publication of the U.S. Office of Education. The Directory was scanned for other institutions which should possibly be in the study, and college bulletins were checked to see if institutions in question offered degrees in mathematics.

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[2] A Catalogue Survey of College Mathematics Courses, CUPM, Mathematical Association of America, Report No. 4, December 1961. 37 pp.

[3] Report No. 94, National Opinion Research Center, University of Chicago, October 1963. 252 pp.

[4] "Trends in the Education of Secondary-School Mathematics Teachers," The Mathematics Teacher, Vol. 54, No. 6, October 1961. pp. 413-22.

[5] "Curricula for Education of Teachers," The American Mathematical Monthly, Vol. 70, No. 2, February 1963. pp. 202-03.

In this way, a total of 1,014 institutions (counting the 4-year degree-granting branches of complex institutions as separate institutions) was obtained. In addition to these 1,014 institutions, 55 others that did not award degrees in mathematics but that offered substantial programs in mathematics were included, making a total of 1,069 institutions.

The questionnaire forms became available for distribution in the middle of January 1961. This caused a slight inconvenience for respondents at institutions that were on a quarter basis; the questionnaire sought data on enrollments in various courses as of Fall 1960, but these institutions were already in the Winter quarter. Except for enrollments, the data of this survey reflect programs in effect during Winter and Spring of 1961.

Response Rate

The questionnaires were mailed out in January 1961. In March and April, follow-up letters were mailed to non-respondents. At the same time, questionnaires which had been received incompletely answered or in need of correction were returned to the respondents for further attention (unless the questionable responses could be obviated by reference to the appropriate college catalog). June 15, 1961, was made the final cutoff date. By that time a total of 877 usable questionnaires--out of the 1,069 mailed out--had been received. These 877 questionnaires provided the data for the statistical analyses in this report.

A check of all graduate institutions in the Education Directory, 1960-61: Part 3, Higher Education, revealed that data on graduate programs in mathematics were received from better than 95 percent of institutions having master's programs in straight mathematics or in mathematics for teaching. A 100-percent coverage was achieved for institutions offering doctoral programs in mathematics or in mathematics for teaching.

Categories Used for Analysis

To make the statistical analysis as complete and comprehensive as possible, the survey data were analyzed by type of institution, by control, by region, and by enrollment size, as follows:

Type of Institution

Universities
Liberal arts colleges
Teachers colleges
Technological schools

Control

Public institutions
Private institutions

Region

North Atlantic (Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont)

Great Lakes and Plains (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin)

Southeast (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, West Virginia, and Puerto Rico)

West and Southwest (Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oklahoma, Oregon, Texas, Utah, Washington, and Wyoming)

Enrollment size

Over 5,000 students
1,500 to 5,000 students
700 to 1,499 students
Under 700 students

The response rate for each of these classifications is shown in table 1, which indicates that there were no significant variations. The lowest response rate occurred among the smallest institutions, particularly in the Southeast region.

All the data relating to the graduate portion of the questionnaire and part of the undergraduate portion were processed manually. The rest of the data, which pertained chiefly to enrollments, were put on punch cards and processed by machine.

Table 1.--Number of institutions to which questionnaires were mailed and percent of usable responses, by type, control, region, and enrollment size: Aggregate United States, 1960-61

Category of institution	Number of institutions to which questionnaires were mailed[1]	Number of institutions which returned usable questionnaires	Rate of response
(1)	(2)	(3)	(4)
All institutions	1,069	877	82
Type			
Universities..............	158	139	88
Liberal arts colleges......	701	570	81
Teachers colleges..........	173	136	79
Technological schools......	37	32	86
Control			
Public....................	366	291	80
Private....................	703	586	83
Region			
North Atlantic.............	296	256	86
Great Lakes and Plains.....	311	270	87
Southeast..................	268	198	74
West and Southwest.........	194	153	79
Enrollment size			
Over 5,000.................	163	143	88
1,500-5,000................	261	221	85
700-1,499..................	306	250	82
Under 700..................	339	263	78

[1] For purposes of this survey 4-year branches of complex institutions have been counted as separate institutions.

Copy of the Questionnaire Form

Note. Wherever possible, the major topic headings in this book bear a cross-reference to the relevant questionnaire item or section. The book does not take up all the items in the same order in which they appear on the questionnaire.

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APPROVAL EXPIRES 6/30/61

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF EDUCATION – DIVISION OF HIGHER EDUCATION
WASHINGTON 25, D. C.

SURVEY OF MATHEMATICS PROGRAMS IN INSTITUTIONS GRANTING BACHELOR AND HIGHER DEGREES

THIS COPY FOR YOUR FILE

PLEASE COMPLETE AND RETURN BY JAN. 6;
if not, as soon thereafter as possible

DATE: DEC. 15, 1960

TO: HEAD OF MATHEMATICS INSTRUCTION

In recent years our country has become increasingly aware of the importance of mathematics in our national welfare. The passage of the National Defense Education Act of 1958 and the expanded programs of the National Science Foundation are evidences that the Federal Government is interested in the strengthening and improvement of mathematics instruction in our educational institutions.

There has been a growing concern regarding the character and content of mathematics programs in colleges and universities. There has been a serious lack of information on a national basis relative to the status of, and trends in, these programs. Among others, the Committee on the Undergraduate Program, The Mathematical Association of America, has underscored the need for information of this kind. It is for these reasons that this study, *Survey of Mathematics Programs in Institutions Granting Bachelor and Higher Degrees,* is being undertaken. The findings should be useful to the mathematics community, to institutions in evaluating their own programs, to legislative bodies, and to educators generally.

The members of the Committee on the Undergraduate Program as well as a number of chairmen of departments of mathematics have assisted in the planning of this study. In the belief that the information sought is needed and will serve a useful purpose, they have offered many valuable suggestions in the preparation of the questionnaire instrument.

The questionnaire has been designed to facilitate responses as much as possible. Part One of the questionnaire deals with undergraduate programs and general information about mathematics and mathematics education, and will involve all institutions. Part Two concerns graduate programs in mathematics and mathematics education, and will involve only the institutions which offer such programs.

Please complete the attached questionnaire at your earliest convenience. Two copies are enclosed, one to be returned in the franked envelope which has been provided you, and the other for your files. Your cooperation will be much appreciated. Each respondent will receive a copy of the report when it is published.

Please note that we would like to receive the enclosed Acknowledgment Card upon your receipt of this questionnaire. The Acknowledgment Card also affords you an opportunity to advise us of other persons in your institution who should be contacted regarding its programs in mathematics (including mathematical statistics).

Sincerely yours,
Clarence B. Lindquist
Clarence B. Lindquist
Chief for Natural Sciences and Mathematics
Division of Higher Education

Enclosures

GENERAL INSTRUCTIONS

You are to report on mathematics programs (including mathematical statistics) under your cognizance. Data on programs under the cognizance of other heads of your or other campuses (if any) of your institution will be reported by these other heads.

For the most part questions are asked relative to your department. In some institutions mathematics may not have a departmental status. Even though this may be true in your case, respond as if your activity had departmental status.

In case your answer to a question requires qualification, write it as near to the question as possible. Answer questions according to practices and programs (curriculums) as they exist at the time you fill out this questionnaire. However, indicate, where applicable, any new developments under consideration which are likely to be approved in the near future.

Please send along any descriptive material (printed or otherwise) about your mathematics programs. It is planned to describe a sample of promising and interesting programs in the bulletin forthcoming from this survey, as examples of what can be done and what is being done.

Coding numbers appear on many of the questions and items. These are used merely for the convenience of the Office of Education in tabulating the returns.

PART I – UNDERGRADUATE PROGRAMS AND GENERAL INFORMATION

1 PLAN UNDER WHICH YOUR INSTITUTION OPERATES *(Check one)*

1 ☐ SEMESTER 2 ☐ QUARTER 3 ☐ OTHER *(Specify)*

2 AMONG *ENTERING FRESHMEN*, HOW MANY ARE ENROLLED IN THE FOLLOWING LEVELS OF COURSES IN THE FALL TERM OF 1960?

COURSES	NUMBER OF ENTERING FRESHMAN ENROLLED
COURSES OF LEVEL PRECEDING COLLEGE ALGEBRA AND TRIGONOMETRY	
COLLEGE ALGEBRA, TRIGONOMETRY, AND COURSES OF EQUIVALENT LEVEL	
ANALYTIC GEOMETRY, CALCULUS, AND COURSES OF EQUIVALENT LEVEL AND ABOVE	

3 UNDERGRADUATE CURRICULUMS WITH A MAJOR IN MATHEMATICS *(For each curriculum offered by your INSTITUTION, give the information as requested below)*

	KIND OF CURRICULUM	CHECK IF OFFERED	NO. OF CREDIT HOURS REQUIRED		DEGREES	
			IN MATHEMATICS	IN PROFESSIONAL EDUCATION *(Educ. courses)* REQ. OF THOSE STUDENTS PREPARING TO TEACH, AS APPLICABLE	NAME OF DEGREE TOWARD WHICH CURRICULUM LEADS *(e.g., B.A., B.S., etc.)*	NO. OF DEGREES AWARDED IN EACH CURRICULUM BETWEEN JUL. 1, 1959 AND JUNE 30, 1960
4	LIBERAL ARTS OR GENERAL					
5	MATHEMATICS TEACHING					
6	STATISTICAL					
7	ACTUARIAL					
8	APPLIED					
9	OTHER *(Specify)*					

INSTRUCTIONS FOR PREPARATION OF TABLE

a. As revealed by a pretest of this questionnaire, the courses listed in column (1) in the following table are given at a number of institutions as freshman-year, sophomore-year, and junior- and senior-year courses (including the fifth year in five-year undergraduate programs). Although your titles may differ from the titles given below, some or all of your courses may fall within these categories. Additional blank spaces are provided to permit you to write in names of courses not falling into these categories. For the purpose of this survey consider as a *single* course instruction in a particular area of mathematics which you have divided up into two or more parts. Omit courses given as remedial or prerequisite instruction in the freshman year. These courses are covered in question 9.

b. For each course in column (1) that is offered, write in column (2) the title(s) of the text(s) used and the name(s) of its author(s). In column (3) write the number of credit hours given for the course (total number of credit hours if the course is given in two or more parts). In column (4) write the total number of students who enrolled in the course in the fall term of 1960 (the total number refers to all students who enrolled in any part of the course). For a course not being offered now, write "0."

c. Place a check (√) in those remaining columns, (5) through (12), where such courses are usually taken by students whose principal interests are indicated by the headings at the top of the columns.

TYPICAL FRESHMAN-YEAR, SOPHOMORE-YEAR, AND JUNIOR- AND SENIOR-YEAR CURRICULUMS IN MATHEMATICS

		NAME OF COURSE IN MATHEMATICS	TITLE(S) OF TEXT(S) USED AND NAME(S) OF AUTHOR(S)	NO. OF CREDIT HOURS GIVEN FOR THE COURSE	TOTAL NO. OF STUDENTS ENROLLED FALL 1960	MAJOR IN MATH.	TEACHING MATH IN SECONDARY SCHOOL	TEACHING MATH IN ELEMENTARY SCHOOL	PHYSICAL SCIENCES AND ENGINEERING	BIOLOGICAL, AGRICULTURAL AND SOCIAL SCIENCES	BUSINESS	CULTURAL EDUC.	OTHER *(Specify instead of check)*
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
a. FRESHMAN YEAR	1	College Algebra											
	2	Trigonometry											
	3	Analytic Geometry											
	4	Analytic Geometry and Calculus											
	5	Math. Analysis *(A combination of alg., trig., etc.)*											
	6	Basic Concepts *(Structure, logic, sets, etc.)*											
	7	General Mathematics *(Basic skills, operations, etc.)*											

	8	Calculus											
	9	Mathematics of Finance											
	10	Elementary Statistics											
	11	Math. for Elementary School Teachers											
	12	Other *(Specify)*											
	13	Other *(Specify)*											
	14	Other *(Specify)*											
b. SOPHOMORE YEAR	1	Calculus											
	2	Analytic Geometry and Calculus											
	3	Differential Equations											
	4	Statistics											
	5	Mathematics of Finance											
	6	Other *(Specify)*											
	7	Other *(Specify)*											
	8	Other *(Specify)*											
	1	Advanced Calculus											
	2	Ordinary Differential Equations											
	3	Partial Differential Equations											
	4	Theory of Equations											
	5	Theory of Numbers											
	6	Probability											
	7	Mathematical Statistics											
	8	Modern Algebra, excluding Continental Classroom											
	9	Continental Classroom											
	10	Matrix Theory											
	11	Vector Analysis											

c. JUNIOR AND SENIOR YEAR	12	Complex Variables											
	13	College Geometry											
	14	Solid Analytic Geometry											
	15	Synthetic Projective Geometry											
	16	Analytic Projective Geometry											
	17	Non-Euclidean Geometry											
	18	Differential Geometry											
	19	Topology											
	20	Math. for Teachers (*Methods, etc.*)											
	21	Foundations of Mathematics											
	22	History of Mathematics											
	23	Arithmetic for College Students											
	24	Numerical Analysis											
	25	Programming for Digital Computers											
	26	Calculus of Finite Differences											
	27	Mathematics of Finance											
	28	Advanced Math. for Engineers and Physicists											
	29	Fourier Series & Boundary Value Problems											
	30	Theoretical or Analytical Mechanics											
	31	Honors Thesis											
	32	Independent Study or Honors Course											
	33	Other (*Specify*)											
	34	Other (*Specify*)											
	35	Other (*Specify*)											
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)

			NO	YES
5		**DOES YOUR INSTITUTION REQUIRE AN ADMISSIONS EXAMINATION OF SOME SORT WHICH INCLUDES MATHEMATICS AS A PART OF IT?** *(Check No or Yes box at right, and if Yes is checked, check applicable items below.)*	☐	☐
	12	COLLEGE ENTRANCE EXAMINATION BOARD APTITUDE EXAMINATION		
	13	COLLEGE ENTRANCE EXAMINATION BOARD ACHIEVEMENT EXAMINATION		
	14	STATE EXAMINATION *(e.g., New York State Regents)*		
	15	YOUR OWN INSTITUTIONAL EXAMINATION		
	16	OTHER *(Specify)*		

			NO	YES
6		**DOES YOUR DEPARTMENT OR COLLEGE ADMINISTER A PLACEMENT EXAMINATION IN MATHEMATICS?** *If Yes, check appropriate items under "a" through "e" following:*	☐	☐
	a	PLACEMENT EXAMINATION IS TAKEN BY:		(✓)
	19	ALL ENTERING FRESHMEN		
	20	STUDENTS TAKING MATHEMATICS IN COLLEGE FOR THE FIRST TIME		
	21	STUDENTS *in special curriculums only (e.g., engineering, physical sciences, etc.)*		
	22	OTHER *(Specify)*		
	b	PLACEMENT EXAMINATION TESTS FOR A KNOWLEDGE OF:		(✓)
	23	ALGEBRA		
	24	GEOMETRY		
	25	TRIGONOMETRY		
	26	OTHER *(Specify)*		
	c	OBJECTIVES OR PURPOSES OF PLACEMENT EXAMINATION ARE:		(✓)
	27	*To determine which students have the necessary mathematical knowledge to undertake regular college courses and which are inadequately prepared to do so.*		
	28	*To determine the mathematical aptitude of the student*		
	29	*To section students into groups having about the same ability level*		
	30	*To determine the specific course in which the student will be permitted to enroll*		
	31	OTHER *(Specify)*		

d	ARE STANDARDIZED OR NATIONALLY DISTRIBUTED EXAMS USED? ☐ NO ☐ YES	IF YES, GIVE NAME OF THIS EXAM.
e	FURTHER COMMENT, IF ANY, ON THE PLACEMENT EXAMINATION	

		NO	YES
7	**DOES YOUR INSTITUTION HAVE A SPECIAL PROGRAM, SUCH AS AN HONORS PROGRAM, FOR SUPERIOR UNDERGRADUATE MATHEMATICS STUDENTS?**	☐	☐
	IF YES, briefly describe this program, naming texts used, if any. Also, send any descriptive material you may have on the program.		

			NO	YES
8	a	**DOES YOUR INSTITUTION HAVE A PROGRAM OF ADVANCED STANDING IN MATH.** *(i.e., a program whereby a student, by virtue of having completed math. of college grade in high school or by having passed an examination, is permitted to enroll in a mathematical course more advanced than a course in which the typical entering student is permitted to enroll)? If yes, respond to (b) and (c) below.*	☐	☐
	b	**IS COLLEGE CREDIT, COUNTING TOWARD GRADUATION CREDIT REQUIREMENTS,** *entered on the student's record for the courses in college which the student was permitted to skip? If yes, check below, as appropriate:*	☐	☐

	COURSES CREDITS ARE GIVEN IN:	(✓)			ADVANCED STANDING IS BASED UPON:	(✓)
40	COLLEGE ALGEBRA		c	45	RECOMMENDATION OF HIGH SCHOOL	
41	TRIGONOMETRY			46	PROFICIENCY EXAM. MADE & ADMINISTERED LOCALLY	
42	ANALYTIC GEOMETRY			47	PROFICIENCY EXAM. BY NATIONAL AGENCY, IDENTIFY:	
43	CALCULUS					
44	OTHER *(Specify)*			48	OTHER *(Specify)*	

		NO	YES
9	*Is prerequisite instruction in math. (for credit or without credit) offered by your institution to correct the deficiencies of students who are beginning to take college mathematics for the first time? (What constitutes prerequisite instruction varies from institution to institution. Respond according to your practice in this regard.) If yes, respond to (a) and (b) below:*	☐	☐

a		COURSES GIVEN AS PREREQUISITE INSTRUCTION	CHECK (✓) IF OFFERED	NUMBER OF CREDIT HOURS GIVEN	TOTAL NO. OF STUDENTS ENROLLED (Fall 1960)
	3	PLANE GEOMETRY			
	4	SOLID GEOMETRY			
	5	ELEMENTARY ALGEBRA			
	6	INTERMEDIATE ALGEBRA			
	7	COLLEGE ALGEBRA			
	8	TRIGONOMETRY			
	9	OTHER *(Specify)*			

b **PREREQUISITE INSTRUCTION IS GIVEN** *(Check appropriate one(s)):*

10 ☐ AS A REGULAR SERVICE OF YOUR DEPARTMENT 11 ☐ IN AN EXTENSION ACTIVITY AT YOUR INSTITUTION 12 ☐ OTHER MEANS *(Specify)* ____

		NO	YES
c	*If prerequisite instruction is not offered now, has it been offered at any time during the past ten years as part of the regular college mathematics program?*	☐	☐
d	*If answer to "c" is Yes, in what year and for what reason was such prerequisite instruction as a part of the regular college math program discontinued?*		

		NO	YES
10	**DOES YOUR INSTITUTION HAVE A REQUIREMENT THAT *EVERY STUDENT*,** *in order to graduate with a baccalaureate degree, must have taken at least one college-level mathematics course? (It is well known, of course, that in large institutions requirements within colleges and in different programs vary. What is desired to be known here is whether or not there exists an institution-wide requirement that some college-level mathematics be taken.)*	☐	☐

			NO	YES
11		**DOES YOUR DEPARTMENT REQUIRE AN UNDERGRADUATE THESIS OF ANY OF YOUR MAJORS?** *(If Yes, check below as appropriate the kinds of your student majors for whom this is a requirement)*	☐	☐
	19	ALL MATHEMATICS STUDENTS		
	20	HONOR STUDENTS ONLY		
	21	OTHER *(Specify)*		

			NO	YES
12	a	Is there an undergraduate mathematics club on your campus? If yes, is the club (Check one)		
		AFFILIATED WITH PI MU EPSILON?		
		AFFILIATED WITH KAPPA MU EPSILON?		
		A LOCAL CLUB WITH NO AFFILIATION?		
		OTHER (Specify)		

FORMS OF PROGRAMS (Check as many as apply)	(✓)	NO. OF MEETINGS PER ACAD. YR.	(✓)
PAPERS GIVEN BY CLUB MEMBERS		1 TO 3	
TALKS BY FACULTY MEMBERS		4 TO 7	
SPEAKERS FROM OUTSIDE THE INSTITUTION		8 TO 10	
OTHER (Specify)		MORE THAN 10	

			NO	YES
b		Does your department sponsor any activities, excluding mathematics clubs, to stimulate interest in math. (e.g., math. contests, visiting lecturers, etc.)? If yes, check below those activities which pertain:		
		MATHEMATICS CONTESTS (Specify)		
		VISITING LECTURERS		
		NEWSLETTERS OR BULLETINS TO HIGH SCHOOLS TO PROVIDE LEADERSHIP AND CREATE INTEREST IN MATHEMATICS (Give samples)		
		OTHER (Specify)		

			NO	YES
13		Does your department make use of any techniques other than the standard or traditional lecture-recitation system? If yes, place a check in the box at the right for each technique you use:		
	9	LARGE LECTURE CLASSES WITH SMALL QUIZ SECTIONS		
	10	LARGE LECTURE CLASSES WITH HELP SESSIONS		
	11	ORGANIZED PROGRAM OF INDEPENDENT STUDY		
	12	"CONTINENTAL CLASSROOM" COURSE BY TELEVISION		
	13	OTHER BROADCAST TELEVISION COURSES		
	14	COURSES BY CLOSED-CIRCUIT TELEVISION		
	15	COURSES BY FILM		
	16	OTHER (Specify)		

14 a		Does your institution have a library separate from the main library? (Check one of the following)	(✓)
	17	YES, FOR MATHEMATICS ALONE	
	18	YES, FOR MATHEMATICS AND (E.G., SCIENCE, PHYSICS, ETC.) ______ ALONE (FIELD)	
	19	NO SEPARATE LIBRARY FOR MATHEMATICS ALONE OR MATHEMATICS IN COMBINATION WITH ONE OR MORE OF THE SCIENCES ALONE	
b		If the item immediately preceding is checked, does your department desire a library separate from the main library? (Check one)	(✓)
	20	YES, FOR MATHEMATICS ALONE	
	21	YES, FOR MATH. IN COMBINATION WITH ONE OR MORE OF THE SCIENCES ALONE	
	22	YES, BUT NO PARTICULAR PREFERENCE BETWEEN A SEPARATE LIBRARY FOR MATHEMATICS ALONE OR ONE FOR MATH. IN COMBINATION WITH ONE OR MORE OF THE SCIENCES ALONE	
	23	DO NOT DESIRE A LIBRARY SEPARATE FROM THE MAIN LIBRARY	

			NO	YES
15	a	Does your department have any special equipment or facilities for mathematics instruction, the scheduling of which is the responsibility of your department? If yes, give information below.		
		High-speed computer(s). (How many, make and model no., and year of installation. If none, so indicate.)		
		NO. OF DESK CALCULATORS. IF NONE, SO INDICATE. ______	OTHER (Specify)	
	b	Does your department have available to it any equipment or facilities for mathematics instruction, the scheduling of which is not the responsibility of your department? If yes, give information below.		
		High-speed computer(s). (How many, make and model no., and year of installation. If none, so indicate.)		
		NO. OF DESK CALCULATORS. IF NONE, SO INDICATE. ______	OTHER (Specify)	
	c	What special equipment or facilities do you not now have but which are in your judgment desired and needed?		

		NO	YES
16	Omitting National Science Foundation Institutes, did your department offer any program, of at least two weeks duration, specially designed for the inservice education of mathematics teachers during the summer of 1960 and for the academic year 1959-60? (Information on NSF Institutes will be obtained from the Foundation, making it unnecessary for you to supply this information.)		

a		If yes, check level(s) for which such inservice training was given:	(✓)
	37	FOR ELEMENTARY TEACHERS ONLY	
	38	FOR JUNIOR HIGH TEACHERS ONLY	
	39	FOR SENIOR HIGH TEACHERS ONLY	
	40	FOR ELEMENTARY AND JUNIOR HIGH TEACHERS ONLY	
	41	FOR JUNIOR HIGH AND SENIOR HIGH TEACHERS ONLY	
	42	FOR ELEMENTARY JUNIOR HIGH, AND SENIOR HIGH TEACHERS	
	43	FOR COLLEGIATE TEACHERS ONLY	
	44	FOR HIGH SCHOOL AND COLLEGIATE TEACHERS	
b	45	Check the financial sponsorship of the program (Check as many as apply):	(✓)
	46	YOUR OWN INSTITUTION	
	47	PRIVATE CORPORATION OR FOUNDATION. Give name or names of sponsoring organizations:	
	48	OTHER (Specify)	
c		Check type(s) of program(s) offered:	(✓)
	1	SUMMER INSTITUTE	
	2	LATE AFTERNOONS, EVENINGS, OR SATURDAYS	
	3	ACADEMIC-YEAR, FULL-TIME INSTITUTE	
	4	OTHER (Specify)	

17 **INNOVATIONS IN UNDERGRADUATE MATHEMATICS PROGRAMS SINCE 1950**

It is desired to know the innovations in undergraduate mathematics programs at your institution since 1950. Below are listed some possible changes which may have occurred. Place a check (✓) in the appropriate box for each such innovation occurring at your institution since 1950. After going through the checklist you are invited to make any comment you desire regarding these innovations, or ones not contained in the checklist below. It will not be necessary to comment on honors and advanced standing programs since they have already been covered.

	Check in the right-hand box as applicable:	(✓)
5	HAVE INTRODUCED NEW DEGREE PROGRAMS	☐
6	HAVE SUBSTANTIALLY EXPANDED COURSE OFFERINGS	☐
7	HAVE INTRODUCED FRESHMAN COURSES EMPHASIZING SUCH CONCEPTS AS STRUCTURE, LOGIC, SET THEORY, ETC.	☐
8	HAVE PROVIDED NEW COURSES CONSIDERED APPROPRIATE FOR BIOLOGICAL AND SOCIAL SCIENCE MAJORS	☐
9	HAVE INTRODUCED A NEW PROGRAM, OR HAVE SUBSTANTIALLY ALTERED A PREVIOUS PROGRAM, FOR THE UNDERGRADUATE PREPARATION OF MATHEMATICS TEACHERS	☐
10	HAVE PROVIDED COURSES AND INSTRUCTION LEADING TO CAREERS IN DATA PROCESSING AND COMPUTING	☐
11	HAVE INTRODUCED AN HONORS PROGRAM	☐
12	HAVE INTRODUCED AN ADVANCED STANDING PROGRAM	☐

COMMENTS, IF ANY, ON INNOVATIONS CHECKED ABOVE. ALSO MENTION AND DISCUSS ANY INNOVATIONS INTRODUCED SINCE 1950 AND NOT LISTED ABOVE.

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13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

18 **OBSERVATIONS AND COMMENTS**

In the space below you are invited to make any observations and comments you wish about the undergraduate mathematics programs at your institution. Particularly desired are comments on successful methods in dealing with curriculum problems which could be of help to others, unsolved problems, needed improvements, and suggested ways of bringing about these improvements. (Extend these remarks on additional pages or submit pertinent staff papers.)

INFORMATION SUPPLIED BY

NAME AND TITLE	DATE

PART II – GRADUATE PROGRAMS (If your department has no graduate program leading to a degree in mathematics or the teaching of mathematics, check here ☐ and OMIT the remainder of this questionnaire.

	Place a check in the box at the right below for each type of program your institution offers:	(✓)
a	A MASTER'S PROGRAM WITH A MAJOR IN MATHEMATICS	
b	A MASTER'S PROGRAM SPECIALLY DESIGNED FOR THE TEACHING OF MATH.	
c	A DOCTOR'S PROGRAM WITH A MAJOR IN MATHEMATICS	
d	A DOCTOR'S PROGRAM SPECIALLY DESIGNED FOR THE TEACHING OF MATHEMATICS	

GENERAL INSTRUCTIONS

For each type of program you have checked at the left, fill-in, where appropriate, Section A, B, C and D following. In case you have more than one program of one type (e.g., a master's plan A and a master's plan B) give the information for one program as requested. Then, in the space provided in each section, point out the differences that exist in the other program or programs with respect to the questions which have been asked. Also, do not overlook Sections E and F.

SECTION A – MASTER'S PROGRAMS WITH A MAJOR IM MATHEMATICS

1 NAME OF MASTER'S DEGREE TO WHICH THIS PROGRAM LEADS (*e.g., M.A., M.S.*)

2 NO. OF CREDIT HOURS BEYOND THE BACCALAUREATE REQUIRED FOR THE DEGREE (*Include Credits for Thesis if they are part of the requirement*)

6	IN MATHEMATICS ONLY	14	MINIMUM TOTAL NUMBER OF ALL CREDIT HOURS

3 REQUIREMENTS FOR THE ABOVE DEGREE

THESIS (*Check one*)

22 ☐ REQUIRED 23 ☐ OPTIONAL 24 ☐ NOT PROVIDED FOR

FINAL COMPREHENSIVE EXAMINATION (*Check appropriate one(s)*)

25 ☐ ORAL 26 ☐ WRITTEN 27 ☐ NONE

FOREIGN LANGUAGE OR APPROPRIATE SUBSTITUTION

28 ☐ NO 29 ☐ YES

IF YES, DESCRIBE LANGUAGE REQUIREMENTS

MINOR (*Check one*)

30 ☐ REQUIRED 31 ☐ OPTIONAL 32 ☐ NOT PROVIDED FOR

4 IS THE DEGREE OBTAINABLE BY EITHER OR BOTH OF THE FOLLOWING METHODS? (*Check if so*)

33 ☐ SUMMER STUDY ALONE 34 ☐ EVENING AND/OR SATURDAY STUDY ALONE (*Include degree credit courses offered by your department off campus*)

5 DOES YOUR DEPARTMENT OFFER A MINOR WHICH COULD BE USED IN CONJUNCTION WITH A MASTER'S DEGREE IN ANOTHER DEPARTMENT?

35 ☐ NO 36 ☐ YES

6 VARIATIONS, IF ANY, IN MASTER'S DEGREE PROGRAMS IN MATHEMATICS. See GENERAL INSTRUCTIONS AT TOP OF PAGE.

SECTION B – MASTER'S PROGRAMS SPECIALLY DESIGNED FOR TEACHING OF MATHEMATICS

1 NAME OF MASTER'S DEGREE TO WHICH THIS PROGRAM LEADS (*e.g., M.A., M.Ed., M.A.T.*)

2 NO. OF CREDIT HOURS BEYOND THE BACCALAUREATE REQUIRED FOR THE DEGREE (*Include credits for thesis if they are part of the requirement*)

5	IN MATHEMATICS ONLY	14	MINIMUM TOTAL NO. OF ALL CREDIT HOURS	22	IN PROFESSIONAL EDUCATION (*Education courses*)

3 REQUIREMENTS FOR THE ABOVE DEGREE

THESIS (*Check one*)

30 ☐ REQUIRED 31 ☐ OPTIONAL 32 ☐ NOT PROVIDED FOR

FINAL COMPREHENSIVE EXAMINATION (*Check appropriate one(s)*)

33 ☐ ORAL 34 ☐ WRITTEN 35 ☐ NONE

FOREIGN LANGUAGE OR APPROPRIATE SUBSTITUTION

36 ☐ NO 37 ☐ YES

IF YES, DESCRIBE LANGUAGE REQUIREMENTS:

MINOR (*Check one*)

38 ☐ REQUIRED 39 ☐ OPTIONAL 40 ☐ NOT PROVIDED FOR

4 IS THE DEGREE OBTAINABLE BY EITHER OR BOTH OF THE FOLLOWING METHODS? (*Check if so*)

41 ☐ SUMMER STUDY ALONE 42 ☐ EVENING AND/OR SATURDAY STUDY ALONE (*Include degree credit courses offered by your department off campus*)

5 DOES YOUR DEPARTMENT OFFER A MINOR WHICH COULD BE USED IN CONJUNCTION WITH A MASTER'S DEGREE IN ANOTHER DEPARTMENT?

43 ☐ NO 44 ☐ YES

6 VARIATIONS, IF ANY, IN MASTER'S DEGREE PROGRAMS SPECIALLY DESIGNED FOR THE TEACHING OF MATHEMATICS. SEE GENERAL INSTRUCTIONS AT TOP OF PAGE.

SECTION C – DOCTORAL PROGRAM WITH A MAJOR IN MATHEMATICS

1 NAME OF DOCTOR'S DEGREE CONFERRED (*e.g., Ph.D., Sc.D.*)

2 NUMBER OF CREDIT HOURS IN MATHEMATICS REQUIRED BEYOND THE BACCALAUREATE: ________________

3 MINIMUM TOTAL NUMBER OF CREDIT HOURS REQUIRED FOR THE DEGREE BEYOND THE BACCALAUREATE: ________________

4 EXAMINATIONS YOUR DEPARTMENT REQUIRES IN THE PARTIAL FULFILLMENT OF THE DOCTORAL DEGREE (*Check appropriate ones*)

		(✓)
29	ORAL PRELIMINARY OR QUALIFYING EXAMINATION	
30	WRITTEN PRELIMINARY OR QUALIFYING EXAMINATION	
31	FINAL COMPREHENSIVE ORAL EXAMINATION	
32	FINAL COMPREHENSIVE WRITTEN EXAMINATION	
33	ORAL EXAMINATION ON THESIS	
34	OTHER (*Specify*)	

5 IS COMPETENCY IN ONE OR MORE FOREIGN LANGUAGES REQUIRED? IF YES, GIVE INFORMATION REQUESTED BELOW: 35☐ NO 36☐ YES

37 IN HOW MANY LANGUAGES IS COMPETENCY REQUIRED? ________________

In the table below are listed several foreign languages. Blank spaces are provided for writing the name of other languages not listed. Check each language which your department accepts toward meeting language requirements and each language which in addition to being acceptable, is also preferred.

LANGUAGE		ACCEPTABLE (✓)		PREFERRED (✓)		LEVEL OF FOREIGN LANGUAGE COMPETENCY REQUIRED OF THE STUDENT		(✓)
a	GERMAN	40		45		50	READING COMPREHENSION	
b	FRENCH	41		46		51	LISTENING COMPREHENSION	
c	RUSSIAN	42		47		52	ABILITY TO SPEAK	
d		43		48		53	ABILITY TO WRITE	
e		44		49		54	OTHER (*Specify*)	

COMMENTS, IF ANY, ON FOREIGN LANGUAGE REQUIREMENTS, INCLUDING POSSIBLE SUBSTITUTIONS, IF THEY ARE PERMITTED:

6 IN THE REQUIREMENTS FOR THE DEGREE IS A MINOR OR MINORS:
Check one: 2☐ REQUIRED 3☐ OPTIONAL 4☐ NOT PROVIDED FOR

7 IS THIS DEGREE OBTAINABLE BY EITHER OR BOTH OF THE FOLLOWING METHODS? (*Check if so*)
5☐ SUMMER STUDY ALONE 6☐ EVENING AND/OR SATURDAY STUDY ALONE (*Include credit courses offered by your department off campus*).

8 AREAS OF SPECIALIZATION IN MATHEMATICS AND DOCTORAL DEGREES GRANTED BY YOUR DEPARTMENT SINCE THE BEGINNING OF JANUARY 1958. (*Check and give number of doctoral degrees granted in each area in space provided below*):

AREA OF SPECIALIZATION		(✓) IF OFFERED	NO. OF DR. DEGREES
7	ALGEBRA		
8	ANALYSIS		
9	APPLIED MATHEMATICS		
10	GEOMETRY		
11	LOGIC		
12	STATISTICS		
13	TOPOLOGY		
14	OTHER (*Specify*)		

VARIATIONS, IF ANY, IN DOCTORAL DEGREE PROGRAMS IN MATHEMATICS

SECTION D – DOCTORAL PROGRAM SPECIALLY DESIGNED FOR TEACHING OF MATHEMATICS

1 NAME OF DOCTOR'S DEGREE CONFERRED (*e.g., Ed.D., Ph.D.*)

2 NUMBER OF CREDIT HOURS IN MATHEMATICS REQUIRED BEYOND THE BACCALAUREATE: ________________

3 NUMBER OF CREDIT HOURS IN PROFESSIONAL EDUCATION (*Education Courses*) REQUIRED BEYOND THE BACCALAUREATE: ________________

4 MINIMUM TOTAL NUMBER OF CREDIT HOURS REQUIRED FOR THE DEGREE BEYOND THE BACCALAUREATE: ________________

5 EXAMINATIONS YOUR DEPARTMENT REQUIRES IN THE PARTIAL FULFILLMENT OF THE DOCTORAL DEGREE (*Check appropriate ones*)

		(✓)
29	ORAL PRELIMINARY OR QUALIFYING EXAMINATION	
30	WRITTEN PRELIMINARY OR QUALIFYING EXAMINATION	
31	FINAL COMPREHENSIVE ORAL EXAMINATION	
32	FINAL COMPREHENSIVE WRITTEN EXAMINATION	
33	ORAL EXAMINATION ON THESIS	
34	OTHER (*Specify*)	

6 IS COMPETENCY IN ONE OR MORE FOREIGN LANGUAGES REQUIRED? IF YES, GIVE INFORMATION REQUESTED BELOW: 35☐ NO 36☐ YES

37 IN HOW MANY LANGUAGES IS COMPETENCY REQUIRED? ________________

In the table below are listed several foreign languages. Blank spaces are provided for writing the name of other languages not listed. Check each language which your department accepts toward meeting language requirements and each language which in addition to being acceptable, is also preferred.

LANGUAGE		ACCEPTABLE (✓)		PREFERRED (✓)		LEVEL OF FOREIGN LANGUAGE COMPETENCY REQUIRED OF THE STUDENT		(✓)
a	GERMAN	40		45		50	READING COMPREHENSION	
b	FRENCH	41		46		51	LISTENING COMPREHENSION	
c	RUSSIAN	42		47		52	ABILITY TO SPEAK	
d		43		48		53	ABILITY TO WRITE	
e		44		49		54	OTHER (*Specify*)	

COMMENTS, IF ANY, ON FOREIGN LANGUAGE REQUIREMENTS, INCLUDING POSSIBLE SUBSTITUTIONS, IF THEY ARE PERMITTED:

7 IN THE REQUIREMENTS FOR THE DEGREE IS A MINOR OR MINORS:
Check one: 2☐ REQUIRED 3☐ OPTIONAL 4☐ NOT PROVIDED FOR

8 IS THIS DEGREE OBTAINABLE BY EITHER OR BOTH OF THE FOLLOWING METHODS? (*Check if so*)
5☐ SUMMER STUDY ALONE 6☐ EVENING AND/OR SATURDAY STUDY ALONE (*Include credit courses offered by your department off campus*).

9 HOW MANY DEGREES IN DOCTORAL PROGRAMS SPECIALLY DESIGNED FOR THE TEACHING OF MATHEMATICS HAVE BEEN GRANTED BY YOUR INST. SINCE THE BEGINNING OF JANUARY 1958?
NO. OF DEGREES: ________________

VARIATIONS, IF ANY, IN DOCTORAL DEGREE PROGRAMS SPECIALLY DESIGNED FOR THE TEACHING OF MATHEMATICS

E DOES YOUR INSTITUTION OFFER COURSES OR SEMINARS IN COLLEGE TEACHING OR OTHER ASPECTS OF HIGHER EDUCATION *(e.g., how to teach in college, problems of higher education, the college curriculum, etc.)?* 1☐ NO 2☐ YES

IF YES, WITH REGARD TO STUDENTS MAJORING IN YOUR DEPARTMENT AND CONSIDERING CAREERS IN COLLEGE TEACHING, ARE SUCH COURSES OR SEMINARS (Check one): 3☐ REQUIRED 4☐ NOT REQUIRED BUT ENCOURAGED 5☐ NOT REQUIRED AND NOT PARTICULARLY ENCOURAGED

IF SUCH COURSES OR SEMINARS ARE OFFERED, BRIEFLY DESCRIBE THE PROGRAM OFFERED:

F Describe any innovations in graduate programs in mathematics and in the teaching of mathematics which have taken place at your institution since 1950. For example, a new master's or doctoral program may have been expanded to include options not offered before, or some options may have been terminated, or you may have a special program for retired military officers. With the recent increased emphasis on improved preparation of teachers, it is particularly desired to have information on any new programs which have been introduced in this area. Printed and mimeographed descriptions, if they exist, will be much appreciated and may conveniently be substituted in lieu of your written accounts of them.

FOR THE OFFICE OF EDUCATION USE ONLY

6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

CHAPTER II. UNDERGRADUATE PROGRAMS
(Part I of the Questionnaire)

ENTERING FRESHMEN LEVELS IN MATHEMATICS (ITEM 2)

The kind of preparation that students receive in high school has always concerned college authorities, since they must gear their programs to the level of the entering students. In recent years the importance of the level of previous training in mathematics has greatly increased because of the substantial changes in mathematics curriculums.

Of the 877 institutions that returned questionnaires, 855 answered the question of the numbers of freshmen enrolled in Fall 1960 in the three levels of introductory mathematics. Table 2 shows the data for all the responding institutions, as well as for institutions in the various categories. Slightly over half (52 percent) of the entering freshmen in all 855 institutions were enrolled at the level of college algebra, trigonometry, and courses of equivalent level. One-fourth were enrolled in courses of lower level, and slightly fewer than one-fourth (23 percent) in courses of higher level.

Table 2.--Number and percent of entering freshmen enrolled in mathematics courses, by level of courses, and by type, control, region, and enrollment size of institution: Aggregate United States, Fall 1960

(NOTE. 22 institutions of the 877 in the survey were unable to give the breakdown by level.)

Category of institution	Number of institutions providing data	Entering freshmen enrolled in--					
		Courses of level preceding college algebra and trigonometry		College algebra, trigonometry, and courses of equivalent level		Analytic geometry, calculus, and courses of equivalent level and above	
		Number	Percent	Number	Percent	Number	Percent
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
All institutions	855	76,161	25	159,183	52	70,324	23
Type							
Universities...........	134	25,972	20	71,962	55	32,724	25
Liberal arts colleges..	566	29,162	25	63,239	55	23,534	20
Teachers colleges......	125	18,192	47	16,994	44	3,863	10
Technological schools..	30	2,835	14	6,988	35	10,203	51
Control							
Public.................	274	55,283	31	96,774	53	29,124	16
Private................	581	20,878	17	62,409	50	41,200	33
Region							
North Atlantic.........	247	14,274	18	32,036	41	31,170	40
Great Lakes and Plains.	267	21,930	24	51,227	55	19,459	21
Southeast..............	191	23,069	30	45,314	58	9,279	12
West and Southwest.....	150	16,888	29	30,606	53	10,416	18
Enrollment size							
Over 5,000.............	140	31,418	22	75,247	53	36,174	25
1,500-5,000............	214	26,264	28	46,088	50	20,593	22
700-1,499..............	243	12,125	27	23,680	52	9,693	21
Under 700..............	258	6,354	26	14,168	58	3,864	16

Comparisons by Type of Institution

In the universities more than half (55 percent) of the freshmen were enrolled in basic college algebra and trigonometry or in courses of equivalent level; a quarter were enrolled in more advanced courses, and a fifth in less advanced courses. At liberal arts colleges the percentages were about the same, except that a quarter of the freshmen were enrolled in the less advanced mathematics and a fifth in the more advanced. Fewer than 10 percent of the freshmen at teachers colleges were enrolled in courses of a level equivalent to analytic geometry and calculus, whereas nearly a half (47 percent) were in courses at a level below college algebra and trigonometry and 44 percent were enrolled in basic college courses. At the technological institutions, as would be expected, 51 percent of the entering freshmen took advanced mathematics courses, 35 percent took basic college courses, and only 14 percent took the lower-level courses.

There seem to be several reasons for the variations among the different types of institution. Undoubtedly the large number of students who are preparing to be elementary school teachers and who consequently take only elementary mathematics accounts for the high percentage of students at the lowest level of mathematics at the teachers colleges. On the other hand, higher admission requirements in mathematics at technological institutions eliminate many who are only qualified to take the lower-level courses. Furthermore, these institutions, as well as the colleges of engineering and technology within universities, naturally attract those who are both gifted and relatively well-educated in mathematics.

Comparisons by Control

Variations between public and private institutions may stem from the fact that there are so many teachers colleges among the public institutions reporting. The teachers colleges, as we have seen, had the highest percentage of freshmen in the lower-level courses and the lowest percentage in the higher-level ones. Private universities as a group have far higher admissions requirements than public universities, which are often compelled by law to take almost any applicant.

A little over half (53 percent) of the entering freshmen at public colleges were enrolled in courses at the college algebra-trigonometry level, about a third in the lower-level courses, and a sixth in higher-level courses. Private institutions showed just the reverse--a third of the entering freshmen were in the higher-level courses, a sixth in the lower-level.

Comparisons by Region

Geographic regions showed striking differerences. The North Atlantic region had relatively low percentages of freshmen in courses at the lower and basic college levels; 40 percent of freshmen entering colleges in this region took advanced courses. In fact, 32 institutions (mostly private), or about 1 out of every 8, in the region offered no courses lower than analytic geometry or calculus. This is in striking contrast to the Southeast region, where only 12 percent of entering freshmen took advanced courses. Only 2 institutions in this region offered no mathematics below the level of analytic geometry and calculus.

Comparisons by Enrollment Size

The size of enrollment seems important only at the extremes. In 1960, the largest schools enrolled only 22 percent of their incoming freshmen in the lower level courses. On the other hand, the smallest schools enrolled 58 percent of their freshmen in the basic college courses and only 16 percent in advanced courses. These were the largest and the smallest for all four enrollment-size groups.

CHARACTERISTICS OF CURRICULUMS FOR THE MATHEMATICS "MAJOR" (ITEM 3)

Kinds of Curriculum

Since a liberal arts curriculum and a general curriculum serve basically the same purpose and are accordingly essentially the same, the two were combined on the questionnaire into the one category "liberal arts or general."

Table 3 gives the number and percent of various categories of institutions having the different curriculums, as reported by the respondents, who were themselves the judges of whether they offered the curriculums listed. Thus, in interpreting the table, one should allow for possible lack of uniformity in reporting. For example, one institution might offer what it calls an applied mathematics curriculum; another institution might offer approximately the same curriculum, but might consider it an option within the liberal arts or general curriculum. The "mathematics-teaching" curriculum is another case in point. Some institutuions offer a unique curriculum for teaching mathematics which is different from their liberal arts or general curriculum. Undoubtedly, such a curriculum was listed as mathematics-teaching by these respondents. On the other hand, some institutions, principally liberal arts schools, that offer a liberal arts or general curriculum that is frequently taken by teacher trainees apparently also list it as a mathematics-teaching curriculum.

The liberal arts or general curriculum was by far the most common kind, being offered by 87 percent of the 877 participating institutions. Fifty-nine percent reported having a mathematics-teaching curriculum. At most of the institutions that did not report having such a curriculum, students could nevertheless prepare to be mathematics teachers by taking the regular mathematics curriculum and the required number of education courses for teacher certification. Of all the types of participating institutions, the only type at which a student generally could not study to

Table 3.--Number and percent of institutions having specified curriculums with a major in mathematics, by type, control, region, and enrollment size: Aggregate United States, 1960-61

(Note. L = less than 0.5 but not zero percent)

Category of institutions	Number of institutions in category	Number and percent of institutions offering:											
		Liberal arts or general curriculums		Mathematics-teaching curriculums		Statistical curriculums		Actuarial curriculums		Applied curriculums		Other curriculums	
		No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
All institutions.........	877	759	87	521	59	27	3	7	1	36	4	16	2
Type													
Universities.............	139	126	91	83	60	22	16	5	4	16	12	8	6
Liberal arts colleges....	570	545	96	329	58	5	1	2	L	13	2	6	1
Teachers colleges........	136	68	50	103	76	0	0	0	0	1	1	1	1
Technological schools....	32	20	63	6	19	0	0	0	0	6	19	1	3
Control													
Public...................	291	214	74	219	75	17	6	5	2	18	6	9	3
Private..................	586	545	93	302	52	10	2	2	L	18	3	7	1
Region													
North Atlantic...........	256	195	76	120	47	7	3	1	L	15	6	7	3
Great Lakes and plains...	270	245	91	197	73	11	4	5	2	8	3	4	1
Southeast................	198	181	91	110	56	3	2	0	0	2	1	1	1
West and Southwest.......	153	138	90	94	61	6	4	1	1	11	7	4	3
Enrollment size													
Over 5,000...............	263	125	87	93	65	23	9	5	2	18	7	9	3
1,500-5,000..............	250	185	84	143	65	1	L	1	L	11	4	4	2
700-1,499................	221	222	89	146	58	2	1	0	0	4	2	2	1
Under 700................	143	227	86	139	53	1	1	1	1	3	2	1	1

become a secondary school mathematics teacher was the college devoted exclusively to engineering.

Statistical, actuarial, and applied curriculums are not common. They were offered by only 3 percent, 1 percent, and 4 percent, respectively, of the reporting institutions. Sixteen institutions reported having curriculums other than those specifically listed in the questionnaire. These were identified for the most part as "engineering mathematics."

Liberal arts or general curriculums, which were of course more common in liberal arts colleges than in other types of institutions, were also more common in private than in public institutions. Mathematics-teaching curriculums were most popular among teachers colleges, public institutions, institutions of the Great Lakes and Plains region, and the larger institutions. Most of the statistical and actuarial curriculums reported were offered in large universities. Such specialized curriculums as statistics, actuarial science, and applied mathematics are probably difficult to offer in a small institution.

Credit-Hour Requirements for a Mathematics Major

This survey revealed that colleges and universities differ greatly in credit-hour requirements for a major in mathematics. Often, when there was more than one curriculum at an institution, the requirement for a mathematics major differed between curriculums. Institutions commonly specified certain required courses for a major, while allowing the remaining credits to be earned from a selection of additional courses. A few institutions reported requirements of a specific number of credits beyond a certain level, such as calculus.

Credit units varied among the colleges and universities. A majority of them operated on the semester-hour basis, a considerable number on the quarter-hour basis, and a much smaller number on some other basis such as course unit or trimester unit. Since the semester-hour unit was by far the most common, the data reported in other units were converted by the author to semester-hours wherever possible. In the case of quarter-hours, this was done by multiplying by two-thirds and then rounding to the nearest integer. Data that could not be converted were received from only a few institutions, and were omitted from the tabulations.

Liberal arts or general curriculum.--Table 4 shows that the most common mathematics requirement for a liberal arts or general curriculum was in the category of 29-31 semester-hours (usually the requirement is 30). Of all the institutions that provided usable data, 27 percent had this requirement, 35 percent required less than this, and 38 percent required more. A little less than one-fifth (19 percent) of the institutions had a requirement in the 23-25 range and about one-seventh (14 percent) in each of the 26-28 and 32-34 ranges. Sixteen (2 percent) of 716 institutions required 22 or fewer semester-hours and 9 (1 percent) 47 or more.

An analysis of the data by type of institution shows that technological institutions and universities had generally higher requirements for the major than did liberal arts colleges or teachers colleges. Seventy-eight percent of the technological schools and 52 percent of the universities had requirements of 32 or more credits, compared to 35 percent of the liberal arts colleges and 33 percent of the teachers colleges.

Private institutions tended to have lower credit requirements than did public institutions. Thirty-nine percent of the liberal arts colleges had a requirement of 28 or fewer credits compared to 24 percent of the public institutions. The North Atlantic region and the West and Southwest region had generally larger requirements than did the Great Lakes and Plains region or the Southeast region. Comparisons by enrollment size of institutions show a direct relationship between size of institution and number of credits required for the mathematics major. Generally speaking, the largest institutions had the larger credit requirements, and the smallest institutions, smaller credit requirements.

Mathematics-teaching curriculum.--A total of 521, or 59 percent, of the 877 responding institutions reported having a mathematics-teaching curriculum, although, as mentioned earlier, these were not the only schools at

Table 4.--Percent of institutions having specified semester credit-hour requirements in mathematics for a mathematics major in a liberal arts or general curriculum, by type, control, region, and enrollment size: Aggregate United States, 1960-61

(NOTE. Credit-hour requirements reported in quarter-hours have been converted to semester-hours by multiplying by two-thirds and rounding to the nearest integer. Data from institutions using courses as credit units were not usable.)

Category of institution	Number of institutions having this curriculum	Number in column 2 as a percent of all institutions in category	Number of institutions providing usable data	Percent of institutions providing usable data (column 4 ÷ column 2)	Percent[1] of institutions in column 4 having a semester credit-hour requirement in mathematics of:									
					22 or less	23-25	26-28	29-31	32-34	35-37	38-40	41-43	44-46	47 or over
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
All institutions	759	87	716	94	2	19	14	27	14	12	6	3	2	1
Type														
Universities...........	126	91	120	95	2	14	10	23	18	8	15	6	3	2
Liberal arts colleges..	545	96	512	94	2	21	14	29	14	13	4	2	1	1
Teachers colleges......	68	50	66	97	6	14	17	30	10	20	2	0	0	1
Technological schools..	20	63	18	90	0	6	17	0	0	6	22	17	22	11
Control														
Public.................	214	74	208	97	2	11	11	30	15	15	10	4	1	1
Private................	545	93	508	93	2	22	15	26	14	11	5	2	2	1
Region														
North Atlantic.........	195	76	184	94	3	14	11	24	14	15	8	5	4	3
Great Lakes and Plains.	245	91	230	94	3	25	15	29	14	10	2	0	1	2
Southeast..............	181	91	175	97	2	19	18	29	14	13	3	2	0	1
West and Southwest.....	138	90	127	92	2	13	9	27	13	12	17	4	2	1
Enrollment size														
Over 5,000.............	125	87	119	95	2	13	8	24	20	8	15	3	4	3
1,500-5,000............	185	84	182	98	1	12	15	24	14	20	7	4	1	1
700-1,499..............	222	89	207	93	3	22	14	30	13	12	2	1	1	1
Under 700..............	227	86	208	92	3	25	15	29	12	8	5	1	1	1

[1] Detail may not add to 100 because of rounding.

which a student could prepare to become a secondary school mathematics teacher.

Table 5 shows a bimodal distribution in the semester-hour requirements in mathematics. For all institutions combined, 28 percent had a requirement in the 29-31 credit range, and 26 percent in the 23-25 credit range. Compared to liberal arts of general curriculums, mathematics-teaching curriculums had generally less credit-hour requirements. Only 21 percent of the mathematics-teaching curriculums had a semester-hour requirement of 32 hours or more, compared to 38 percent of the liberal arts or general curriculums.

Excluding the few (6) technological schools, teachers colleges as a group had the

Table 5.--Percent of institutions having specified semester credit-hour requirements in mathematics for a mathematics major in a mathematics-teaching curriculum, by type, control, region, and enrollment size: Aggregate United States, 1960-61

(NOTE. Credit hour requirements reported in quarter-hours have been converted to semester-hours by multiplying by two-thirds and rounding to the nearest integer. Data from institutions using courses as credit units were not usable.)

Category of institutions	Number of institutions having this curriculum	Number in column 2 as a percent of all institutions in category	Number of institutions providing usable data	Percent of institutions providing usable data (column 4 ÷ column 2)	Percent[1] of institutions in column 4 having a semester credit-hour requirement in mathematics of:									
					22 or less	23-25	26-28	29-31	32-34	35-37	38-40	41-43	44-46	47 or over
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
All institutions.......	521	59	495	95	11	26	15	28	10	7	2	1	1	0
Type														
Universities[2]..........	83	60	76	92	12	21	22	25	11	5	1	0	1	1
Liberal arts colleges..	329	58	313	95	11	28	14	27	10	6	2	1	1	0
Teachers colleges......	103	76	100	97	9	22	12	33	12	10	2	0	0	0
Technological schools..	6	19	6	100	17	0	0	0	0	0	33	0	50	0
Control														
Public.................	219	75	208	95	10	20	14	33	9	9	3	0	1	1
Private................	302	52	287	95	11	30	15	24	12	5	1	1	1	0
Region														
North Atlantic.........	120	47	111	93	9	23	13	36	9	7	1	1	2	0
Great Lakes and Plains.	197	73	190	96	9	27	17	25	13	6	2	0	1	1
Southeast..............	110	56	107	97	16	31	14	22	9	6	0	2	0	0
West and Southwest.....	94	61	87	93	10	18	13	30	8	9	7	1	3	0
Enrollment size														
Over 5,000.............	93	65	86	93	9	15	21	27	11	8	5	0	3	1
1,500-5,000............	143	65	137	96	11	22	14	30	7	12	2	1	2	0
700-1,499..............	146	58	139	95	11	32	11	31	9	4	1	1	0	0
Under 700..............	139	53	133	96	10	30	15	23	15	4	2	1	0	0

[1] Detail may not add to 100 because of rounding.

[2] More than 83 of the 139 responding universities actually had a mathematics-teaching curriculum. Many of these curriculums were not reported because they were under the control of the school of education, not of the mathematics department.

Table 6.--Percent of institutions having specified semester credit-hour requirements in mathematics for a mathematics major in statistical, actuarial, applied, and "other" curriculums, all institutions: Aggregate United States, 1960-61

(NOTE. Credit-hour requirements reported in quarter-hours have been converted to semester-hours by multiplying by two-thirds and rounding to the nearest integer. Data from institutions using courses as credit units were not usable.)

Kind of curriculum	Number of institutions having this curriculum	Number in column 2 as a percent of all institutions	Number of institutions providing usable data	Percent of institutions providing usable data (column 4 ÷ column 2)	Percent[1] of institutions in column 4 having a semester credit-hour requirement in mathematics of:									
					22 or less	23-25	26-28	29-31	32-34	35-37	38-40	41-43	44-46	47 or over
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Statistical	27	3	22	82	14	9	14	5	27	0	14	14	0	5
Actuarial	7	1	6	86	17	17	17	0	33	0	17	0	0	0
Applied	36	4	32	89	3	6	6	13	13	6	22	13	6	13
Other (Engineering, etc.)	16	2	15	94	0	0	27	7	0	13	20	7	20	7

[1] Detail may not add to 100 because of rounding.

highest credit requirements for mathematics-teaching curriculums. Public institutions generally had slightly higher requirements than did private institutions. In a comparison by regions, the North Atlantic region was highest and the Southeast region lowest. In a comparison by enrollment size, the largest institutions generally had the largest requirements and the smallest institutions the lowest semester-hour requirements in mathematics.

Statistical, actuarial, applied, and "other" curriculums.--Relatively few institutions reported having statistical, actuarial, applied, or "other" curriculums (see table 6). The few "other" curriculums were primarily "engineering mathematics." Because the numbers of statistical, actuarial, applied, or "other" curriculums were rather small, breakdown of data by various categories of institutions is not given as in the case of the liberal arts and mathematics-teaching curriculums. Credit-hour requirements in mathematics were generally higher in applied or engineering mathematics curriculums than in any other kind of curriculum with a major in mathematics.

Credit-Hour Requirements in Professional Education

The statistical findings representing 469 mathematics-teaching curriculums are presented in table 7. Because the semester-hour is the most common type of credit unit, other

Table 7.--Percent of institutions having specified semester-hour requirements in professional education (education courses) for a mathematics-teaching curriculum, by type, control, region, and enrollment size: Aggregate United States, 1960-61

(NOTE. Credit-hour requirements reported in quarter-hours have been converted to semester-hours by multiplying by two-thirds and rounding to the nearest integer. Data from institutions using courses as credit units were not usable.)

Category of institution	Number of institutions having this curriculum	Number in column 2 as a percent of all institutions in category	Number of institutions providing usable data	Percent of institutions providing usable data (column 4 ÷ column 2)	Percent[1] of institutions in column 4 having a semester credit-hour requirement in professional education of:									
					7 or less	8-10	11-13	14-16	17-19	20-22	23-25	26-28	29-31	32 or over
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
All institutions	521	59	469	90	1	2	2	4	32	25	22	6	3	4
Type														
Universities[2]	83	60	73	88	0	6	4	4	25	22	22	4	7	7
Liberal arts colleges	329	58	297	90	1	1	2	5	38	25	19	5	3	2
Teachers colleges	103	76	93	90	0	0	2	1	15	28	29	14	3	8
Technological schools	6	19	6	100	0	17	0	17	50	0	17	0	0	0
Control														
Public	219	75	198	90	1	3	2	3	17	27	26	10	7	6
Private	302	52	271	90	1	1	2	6	42	23	19	4	1	2
Region														
North Atlantic	120	47	101	84	0	2	2	5	47	14	10	8	5	8
Great Lakes and Plains	197	73	182	92	1	1	2	4	39	34	15	3	1	1
Southeast	110	56	102	93	2	0	2	4	21	22	36	5	4	5
West and Southwest	94	61	84	89	0	5	2	4	11	21	33	14	6	4
Enrollment size														
Over 5,000	93	65	81	87	0	7	4	6	26	25	17	5	5	5
1,500-5,000	143	65	132	92	1	1	3	1	22	20	30	11	6	5
700-1,499	146	58	130	89	0	0	1	6	32	31	19	6	3	2
Under 700	139	53	126	91	2	0	2	5	44	23	19	2	0	2

[1] Detail may not add to 100 because of rounding.

[2] More than 83 of the 139 responding universities actually had a mathematics-teaching curriculum. Many of these curriculums were not reported because they were under the control of the school of education, and not of the mathematics department.

credits were converted, if possible, to semester-hours. As in credit-hour requirements in mathematics, there was variation among the institutions in the credit requirements in professional education. For the latter, however, there was a concentration: almost four-fifths (79 percent) of all institutions had a requirement in the range of 17 to 25 credits. Almost one-third (32 percent) had a requirement in the 17-19 range (usually 18 semester-hours). The median requirement for all institutions was in the 20-22 range.

Comparison of the institutions by type, shows that teachers colleges, as expected, had generally the highest professional education requirements. In fact, the mode for teachers colleges was in the 23-25 range, whereas the modes for universities and liberal arts colleges were both in the 17-19 range. Public institutions had, on the average, higher professional education requirements than did private institutions. Institutions in the Southeast region and in the West and Southwest region generally had higher requirements than did institutions in the North Atlantic region and in the Great Lakes and Plains region. Institutions with enrollments between 1,500 and 5,000 students had generally higher requirements in professional education than did institutions of any other size-category.

A total of 120 respondents, 97 of them liberal arts institutions, reported their professional education requirements for prospective teachers following a liberal arts curriculum. Because of this small number a table with detailed breakdowns, like table 7, is not presented here. Suffice it to say, the requirement associated with liberal arts or general curriculums tended to be lower than the requirement associated with the mathematics-teaching curriculum. Twenty-six percent of institutions reporting on the liberal arts of general curriculum reported a requirement of 16 semester-hours or less of professional education, compared to a corresponding figure of 9 percent for institutions reporting on a mathematics-teaching curriculum.

Kinds of Degrees Awarded

There is no uniformity among colleges and universities in the kinds of degrees awarded to students majoring in mathematics. For one thing mathematics has the attributes of both a humanity and a science. Consequently, some regard the bachelor of arts, and some the bachelor of science, as the more appropriate degree. Many institutions decree only one kind of degree for the whole institution, and at some public institutions the kind of degree that may be awarded is determined by statute.

While the bachelor of arts (B.A.) and the bachelor of science (B.S.) are the most commonly offered, the degree of bachelor of science in education (B.S. in Educ.) is not uncommon for mathematics-teaching curriculums.

Liberal arts or general curriculum.--A total of 746 institutions, or 98 percent of those having a liberal arts or general curriculum, identified the degree to which the curriculum led (see table 8). More than half (55 percent) of the institutions awarded only a B.A. degree for such a curriculum; 21 percent, only a B.S.; and 24 percent, either a B.A. or B.S.

As would be expected, the B.A. degree predominated at the liberal arts colleges; at 61 percent of them, this was the only undergraduate degree awarded. Similarly, at 16, or 80 percent, of the technological schools reporting, the B.S. was the only degree awarded. Because so many liberal arts institutions are privately controlled, the percentage of private institutions conferring B.A. degrees only (60 percent) was much higher than the corresponding percentage of public institutions (42 percent). Awarding of only the B.A. degree for this curriculum was most prevalent in the North Atlantic region (66 percent) and least so in the Southeast region (42 percent). Comparison of institutions by enrollment size shows that the smaller institutions tended to offer only the B.A. degree more commonly than did the larger institutions.

Table 8.--Percent of institutions awarding specified degrees in liberal arts or general curriculums with a major in mathematics; by type, control, region, and enrollment size: Aggregate United States, 1960-61

Category of institution	Number of institutions providing data	Response rate (number in column 2 ÷ number of institutions having this curriculum)	Percent[1] of institutions in column 2 in which this curriculum leads to a--		
			B.A. only	B.S. only	B.A. or B.S.
(1)	(2)	(3)	(4)	(5)	(6)
All institutions.......	746	98	55	21	24
Type					
Universities............	124	98	41	24	32
Liberal arts colleges..	534	98	61	18	21
Teachers colleges......	68	100	44	23	33
Technological schools..	20	100	10	80	10
Control					
Public.................	211	99	42	28	28
Private................	535	98	60	19	21
Region					
North Atlantic..........	192	98	66	18	16
Great Lakes and Plains	239	98	57	17	26
Southeast..............	179	99	42	32	26
West and Southwest.....	136	99	54	20	26
Enrollment size					
Over 5,000.............	121	97	45	21	34
1,500-5,000............	185	100	45	29	24
700-1,499..............	219	99	57	18	25
Under 700..............	221	97	66	19	15

[1] Instead of either a B.A. or B.S. degree, two institutions awarded a B.S. in Education degree and another institution, a degree which was not identified. Because of these three curriculums and rounding, the percents in columns 4, 5, and 6 do not always add up to 100.

Mathematics-teaching curriculum.--Information on the kinds of degrees awarded for this curriculum was received from 495 institutions, or about 95 percent of those having such a curriculum. About one-third of the 495 offered a B.A. only (33 percent); about one-third, a B.S. only (32 percent); about one-seventh, a B.A. or B.S. (15 percent); and one-fifth, a bachelor's degree with designation of education in it (20 percent). (See table 9).

Teachers colleges (34 percent) and universities (32 percent) tended, much more than liberal arts colleges (12 percent), to offer a degree with the designation of education, the bachelor of science in education being by far the most popular. Even for teachers colleges, however, the straight B.S. degree, with no allowance for other kinds of degrees, was most common (40 percent). On the other hand, 43 percent of the liberal arts colleges offered a straight B.A. degree exclusively, a fact which accounted for the relatively higher percentages of both private institutions and institutions with enrollments under 700 that offered only a straight B.A. The Southeast region offered only the B.A. degree considerably less than did other regions. Larger institutions tended to offer degrees with the

Table 9.--Percent of institutions awarding specified degrees in mathematics-teaching curriculums with a major in mathematics; by type, control, region, and enrollment size: Aggregate United States, 1960-61

Category of institution	Number of institutions providing data	Response rate (number in column 2 ÷ number of institutions having this curriculum)	Percent[1] of institutions in col. 2 in which this curriculum leads to a--					
			B.A. only	B.S. only	B.A. or B.S.	B.S. in Educ.	B.A. in Educ.	B. Ed.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
All institutions.......	495	95	33	32	15	15	3	2
Type								
Universities...........	77	93	14	34	20	21	7	4
Liberal arts colleges..	313	95	43	28	16	10	1	1
Teachers colleges......	99	96	15	40	10	27	4	3
Technological Schools..	6	100	0	100	0	0	0	0
Control								
Public.................	208	95	18	38	12	25	4	3
Private................	287	95	44	28	18	8	1	1
Region								
North Atlantic.........	110	92	36	35	16	12	1	1
Great Lakes and Plains.	190	96	34	29	16	17	2	2
Southeast..............	107	97	22	40	15	15	5	3
West and Southwest.....	88	98	39	26	14	14	5	2
Enrollment size								
Over 5,000.............	85	91	17	33	19	22	5	4
1,500-5,000............	137	96	26	37	10	20	4	3
700-1,499..............	141	97	36	28	20	13	3	1
Under 700..............	132	95	46	32	14	7	0	1

[1] Two institutions offered degrees other than those given in columns 4 through 9. Because of these two curriculums and rounding, the percents do not add up to 100 percent for some categories.

designation of education more frequently than did smaller institutions. In fact, there was a direct relationship between degrees with this designation and the size-category of institutions.

Statistical, actuarial, applied, and "other" curriculums.--Except for actuarial science, in which only five curriculums were reported on, the most commonly awarded degrees by far in these curriculums was the B.S. degree. (See table 10). In 25 applied mathematics curriculums, or about 71 percent of the 36 reported, the B.S. was the only degree offered.

Table 10.--Percent of institutions awarding specified degrees in statistical, actuarial, applied, and "other" curriculums with a major in mathematics; all institutions: Aggregate United States, 1960-61

Kind of curriculum	Number of institutions providing data on kinds of degrees awarded in this curriculum	Response rate (number in column 2 ÷ number of institutions having this curriculum)	Percent of institutions in column 2 in which this curriculum leads to a--			
			B.A. only	B.S. only	B.A. or B.S.	Degree other than B.A. or B.S.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Statistical......	23	85	26	52	22	0
Actuarial........	5	83	60	40	0	0
Applied..........	35	97	14	71	6	9
Other............	16	100	12	63	12	12

In statistical curriculums, the B.S. was the most common degree awarded, yet the B.A. was the only degree offered in 6 of the 23 curriculums reported.

Distribution of Degrees in Various Curriculums

Since 1947-48, the U.S. Office of Education has annually surveyed the numbers of degrees earned in mathematics at the bachelor's, master's, and doctor's levels; the results have been reported in the annual editions of Earned Degrees Conferred. From 1947-48 through 1954-55, the category "mathematics" appeared on the survey form without subcategories. Since the 1955-56 survey, the category "mathematical subjects," with subcategories "mathematics" and "statistics," has appeared. Respondents have been asked to include degrees in actuarial science with degrees in statistics.

Despite the innovation of 1955-56, nothing was known on a national scale of the distribution of degrees within the several curriculums of mathematics until this present survey was conducted. The survey on Earned Degrees Conferred distinguished between degrees in statistics and mathematics, but not, for example, between degrees in statistics and actuarial science, or between liberal arts degrees in mathematics and mathematics-teaching degrees.

In order to discover the distribution of bachelor's degrees in the various mathematics curriculums, respondents in this survey were asked to report the number of degrees awarded in each curriculum from July 1, 1959, to June 30, 1960. Not all institutions could give this information. Out of 759 institutions having a liberal arts or general curriculum, 130 did not provide the requested data. For mathematics-teaching, the comparable figures were 88 out of 521; for statistics, 9 out of 27; for actuarial science, 1 out of 7; for applied mathematics, 6 out of 36; and for "other" curriculums, 5 out of 16.

The data received are shown in table 11. A total of 8,847 degrees were classified and reported by the respondents. According to Earned Degrees Conferred, 1959-60, an Office of Education survey of all institutions,[1] a total of 11,361 bachelor's degrees in mathematics and 76 bachelor's degrees in statistics (including actuarial science) were conferred. For statistical purposes, however, the Office of Education counts a major in mathematics that is carried on with a co-major in another field only as one-half degree in mathematics and one-half degree in the other field. Hence, there were more graduates with majors in mathematics or statistics than indicated by the Office of Education survey data for that year. It is estimated that the 8,847 degrees in mathematics reported in this present survey were between two-thirds and three-fourths of all the degrees in mathematics awarded in 1959-60.

As table 11 shows, the liberal arts or general curriculum was by far the most popular curriculum, accounting for 58 percent of the bachelor's degree awarded by all institutions. The mathematics-teaching curriculum accounted for 36 percent of the degrees; applied mathematics, 4 percent; and statistics, 1 percent.

As was expected, degrees earned in liberal arts curriculums predominated at liberal arts colleges and hence at private colleges since so many liberal arts colleges are private. Degrees in mathematics-teaching curriculums accounted for 75 percent of the bachelor's degree in mathematics at the teachers colleges, and at the technological schools applied mathematics and "other" (principally, engineering mathematics) accounted for 61 percent of the degrees.

In comparisons by region, the Great Lakes and Plains region was the highest in percent of degrees awarded in the mathematics-teaching curriculum (43 percent of the degrees awarded) and lowest in percent awarded in the liberal arts or general curriculum (52 percent). In comparisons by enrollment size, the small colleges--those with enrollments of fewer than 700--awarded almost two-thirds (65 percent) of their degrees in the liberal arts or general curriculum. Institutions with enrollments between 1,500 and 5,000 students awarded a little less than half (46 percent) of

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[1] Washington: Government Printing Office, 1962.

Table 11.--Percent of bachelor's degrees awarded in specified curriculums with a major in mathematics; by type, control, region, and enrollment size: Aggregate United States, July 1, 1959 to June 30, 1960

(NOTE. L = less than 0.5 but not zero percent.)

Category of institution	Total number of degrees awarded in all curriculums	Percent distribution of degrees in college (2) among:					
		Liberal arts or general	Mathematics teaching curriculums	Statistical curriculums	Actuarial curriculums	Applied curriculums	Other curriculums
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
All institutions.......	8,847	58	36	1	L	4	2
Type							
Universities...........	2,945	67	24	2	L	6	2
Liberal arts colleges..	3,752	70	27	L	L	2	L
Teachers colleges......	1,892	25	75	0	0	L	0
Technological schools..	258	31	7	0	0	36	25
Control							
Public..................	4,754	44	49	1	L	5	1
Private.................	4,093	75	20	1	L	2	2
Region							
North Atlantic.........	2,111	61	30	1	L	4	4
Great Lakes and Plains.	2,974	52	43	1	L	3	1
Southeast..............	2,083	62	36	L	0	2	L
West and Southwest.....	1,679	61	29	1	L	7	2
Enrollment size							
Over 5,000.............	3,255	59	27	2	L	8	3
1,500-5,000............	2,804	52	46	0	0	1	1
700-1,499..............	1,788	62	35	L	0	1	1
Under 700..............	1,000	65	34	L	L	L	L

their degrees in mathematics-teaching curriculums. For reasons explained earlier, it can be assumed that somewhere between 40 and 50 percent of all recipients of bachelor's degrees in mathematics are fully qualified to teach mathematics in secondary schools, even though only 36 percent of all mathematics degrees awarded were in mathematics-teaching curriculums.

COURSE OFFERINGS AND ENROLLMENTS (ITEM 4)

In considering data on enrollment in any given course, the reader should keep in mind that some courses, such as analytic geometry and ordinary differential equations are typically given at the end of the school year; hence, the enrollments cited here, based upon autumn data, are lower for such courses than they would be if they were based on spring data.

The reader should also keep in mind that many subjects that are given separate listing at one institution are combined into a single comprehensive course at another. At some institutions, for example, freshman mathematical analysis is a year-long integrated course consisting of algebra, trigonometry, and analytic geometry; similarly, higher mathematics for engineers often consists of advanced calculus, some advanced algebra, vector analysis, and complex variables.

Freshman Year

Table 12 gives the 16 different freshman courses that were cited with sufficient frequency and enrollment to be listed separately. All other courses were lumped into the "other" category.

Table 12.--Number and percent of institutions offering freshman-year mathematics courses, and number and percent of students enrolled in them: Aggregate United States, Fall 1960

Course	Institutions offering course at some time		Of institutions in column 2, number and percent offering course in Fall 1960		Enrollment: Fall 1960	
	Number	Percent	Number	Percent	Number	Percent of total freshman mathematics enrollment
1	2	3	4	5	6	7
Total	--	--	--	--	374,830	100.0
Plane geometry	145	17	84	58	3,277	0.9
Solid geometry	96	11	50	52	1,429	0.4
Elementary algebra	148	17	109	74	9,183	2.4
Intermediate algebra	303	35	256	84	27,907	7.4
College algebra	572	65	544	95	82,125	21.9
Trigonometry	552	63	408	74	35,926	9.6
Analytic geometry	332	38	228	69	17,957	4.8
Analytic geometry and calculus	360	41	318	88	50,874	13.6
Mathematical analysis	376	43	354	94	46,151	12.3
Basic concepts (including finite mathematics)	246	28	228	93	27,512	7.3
General mathematics	233	27	216	93	32,461	8.7
Calculus	91	10	72	79	5,212	1.4
Mathematics of finance	148	17	93	63	8,026	2.1
Elementary statistics	105	12	61	59	3,827	1.0
Mathematics for elementary school teachers	153	17	117	76	9,761	2.6
Business mathematics	45	5	40	89	5,886	1.6
Other	--	--	--	--	7,316	2.0

The courses most frequently given in the first year were college algebra, trigonometry, and mathematical analysis. They were given by 65 percent, 63 percent, and 43 percent, respectively, of the institutions replying. Enrollment figures showed that college algebra, with an enrollment of 82,125 students, or 21.9 percent of the freshman mathematics enrollment, was the most popular single freshman course, and that analytic geometry and calculus (offered by 41 percent of the institutions) was second with 50,874 students, or 13.6 percent of the total. Mathematical analysis was next with 46,151 students, or 12.3 percent of the total enrollment.

A total of 246 institutions, or 28 percent of those responding, reported that they offered a basic concepts course in mathematics, with a total enrollment of 27,512 students, or 7.3 percent of the total freshman mathematics enrollment. This enrollment reflects a trend, for in recent years more and more colleges and universities have been offering such courses. In fact, many institutions are offering a new course called finite mathematics. The topics covered in a basic concepts course include elementary set theory, logic, and mathematical structure. These courses are often recommended to students to meet general education requirements because they focus on basic understanding of mathematics rather than on the acquisition of skills or techniques which the student not majoring in mathematics or science will soon forget.

The data cited here on business mathematics do not reflect a true picture. Since business mathematics is often taught in the business department rather than the mathematics department, undoubtedly some business mathematics enrollments went unreported. A similar situation exists in elementary statistics, which is sometimes taught in departments other than mathematics.

Sophomore Year

The number and percent of institutions offering various sophomore-year mathematics

Table 13.--Number and percent of institutions offering sophomore-year mathematics courses, and number and percent of students enrolled in them: Aggregate United States, Fall 1960

Course	Institutions offering course at some time		Of institutions in column 2, number and percent offering course in Fall 1960		Enrollment: Fall 1960	
	Number	Percent	Number	Percent	Number	Percent of total sophomore-year mathematics enrollment
1	2	3	4	5	6	7
Total	--	--	--	--	92,847	100.0
Calculus	530	60	501	95	31,144	34.9
Analytic geometry and calculus	370	42	345	93	37,015	39.0
Differential equations	176	20	118	67	9,771	10.3
Statistics	210	24	127	60	5,624	5.9
Mathematics of finance	98	11	45	46	1,771	1.9
Mathematics for elementary school teachers	23	3	18	78	1,396	1.5
Analytic geometry	48	5	44	92	1,304	1.4
Other	--	--	--	--	4,822	5.1

courses and the enrollment in these courses are given in table 13. Only seven courses were offered with sufficient frequency to be listed separately in the table.

Although the straight calculus course was the one given by the greatest percentage of institutions (60 percent), the integrated course, analytic geometry and calculus, offered by 42 percent of the institutions, had the largest enrollment, accounting for 39.0 percent of the total sophomore-year enrollment during Fall 1960.

The fact that differential equations is an end-of-year course at many institutions explains why it accounted for only 10.3 percent of the Fall 1960 enrollment. Statistics and mathematics of finance are offered with less frequency than is calculus in the sophomore year, and this is why these courses account for a lower percentage of the total enrollment.

Junior Year and Senior Year

A great number of different mathematics courses were offered at the junior and senior levels. The course offered by the most institutions (74 percent of them) was advanced calculus, but the greatest enrollment was in ordinary differential equations, which accounted for 15.0 percent of the total mathematics enrollment at this level. (See table 14.)

Other commonly given courses were modern algebra (64 percent of the institutions), mathematical statistics (47 percent), theory of equations (47 percent), college geometry (42 percent), and mathematics for secondary school teachers (40 percent). These courses, along with the two mentioned in the preceding paragraph, generally accounted for the largest enrollments. A significant exception was advanced mathematics for engineers and physicists, a course offered by only 19 percent of the institutions but one which accounted for 6.7 percent of the total mathematics enrollment at this level. Independent study or honors courses were offered by 20 percent of the institutions but accounted for only 0.5 percent of the enrollment. Perhaps the individual attention needed for the supervision of such students accounted in part for the small enrollment.

The data on programing for digital computers do not reflect the full picture, because the respondents were heads of mathematics departments or persons whom they designated to respond. At many universities, however, instruction in digital computing is given in a separate department of digital computing, not in the mathematics department. There is good reason to believe that some respondents failed

Table 14.--Number and percent of institutions offering junior-year and senior-year mathematics courses, and number and percent of students enrolled in them: Aggregate United States, Fall 1960

Course	Institutions offering course at sometime		Of institutions in column 2, number and percent offering course in Fall 1960		Enrollment: Fall 1960	
	Number	Percent	Number	Percent	Number	Percent of total junior- and senior-year mathematics enrollment
1	2	3	4	5	6	7
Total..........................	--	--	--	--	101,277	100.0
Advanced calculus...............	647	74	461	71	12,976	12.8
Oridnary differential equations.	631	72	410	65	15,144	15.0
Partial differential equations..	93	11	45	48	1,621	1.6
Theory of equations.............	409	47	195	48	3,724	3.7
Theory of numbers...............	196	22	74	38	1,486	1.5
Probability.....................	192	22	92	48	2,233	2.2
Mathematical statistics.........	410	47	224	55	5,496	5.4
Modern algebra..................	559	64	334	60	6,824	6.7
"Continental Classroom".........	147	17	137	93	1,756	1.7
Matrix theory...................	186	21	100	54	2,671	2.6
Vector analysis.................	232	26	120	52	3,626	3.6
Complex variables...............	199	23	104	52	2,676	2.6
College geometry................	368	42	156	42	2,958	2.9
Solid analytic geometry.........	167	19	70	42	1,124	1.1
Projective geometry.............	171	19	56	33	789	0.8
Non-Euclidean geometry..........	66	8	19	29	412	0.4
Differential geometry...........	69	8	21	30	322	0.3
Higher geometry and modern geometry.....................	70	8	26	37	438	0.4
Topology........................	126	14	69	55	789	0.8
Mathematics for secondary school teachers...............	354	40	182	51	3,506	3.5
Mathematics for elementary school teachers...............	49	6	38	78	1,614	1.6
Foundations of mathematics......	182	21	89	49	1,862	1.8
History of mathematics..........	206	23	69	33	1,141	1.1
Arithmetic for college students.	35	4	21	60	1,225	1.2
Numerical analysis..............	173	20	94	54	2,178	2.2
Programing for digital computers	102	12	75	74	2,665	2.6
Calculus of finite differences..	37	4	14	38	189	0.2
Mathematics of finance..........	69	8	29	42	1,021	1.0
Advanced mathematics for engineers and physicists......	170	19	121	71	6,750	6.7
Fourier series and boundary value problems...............	66	8	27	41	865	0.9
Theoretical or analytical mechanics......................	61	7	36	59	960	0.9
Honors thesis...................	54	6	43	80	168	0.2
Independent study or honors course........................	179	20	120	67	552	0.5
Finite mathematics..............	29	3	17	59	263	0.3
Linear algebra..................	23	3	13	57	376	0.4
Senior seminar..................	87	10	56	64	444	0.4
Applied statistics..............	27	3	19	70	1,428	1.4
Logic...........................	32	4	14	44	280	0.3
Differential and integral calculus......................	73	8	61	84	1,517	1.5
Higher analysis, theory of functions, real variables.....	66	8	35	53	897	0.9
Operational mathematics.........	14	2	6	43	216	0.2
Set theory......................	11	1	6	55	101	0.1
Higher algebra..................	26	3	18	69	414	0.4
Other...........................	---	---	---	---	3,580	3.5

to obtain the pertinent data from the computing department. Since theoretical and analytical mechanics is often taught in a physics department or an engineering department, enrollment data for this subject are also not believed to have been universally reported.

PREREQUISITE INSTRUCTION (ITEM 9)

Each college and university has what it considers its regular freshman mathematics courses. For students who do not possess the necessary prerequisite courses, many institutions offer courses lower in level than the regular freshman courses. These remedial courses are sometimes given on a credit basis and sometimes without credit.

What is considered prerequisite instruction varies among institutions. Plane geometry, solid geometry, elementary algebra, and intermediate algebra, if they are offered at all, are usually considered remedial. On the other hand, although college algebra and trigonometry are usually regarded as regular courses, at come institutions they are given as prerequisite instruction.

Extent of Prerequisite Instruction and Provision for Credit

Table 15 shows the number and percent of institutions in each category which offered one or more courses of prerequisite instruction and the percent of institutions, based on the total number of institutions in each category, which offered various specific courses. Table 16 shows the percent of institutions among those giving various prerequisite courses that gave college credit for them.

Fifty-eight percent of all institutions offered at least one course in what they considered remedial mathematics. Almost three-fourths of the public institutions offered such instruction whereas only one-half of the private institutions did so. Prerequisite instruction was relatively more than twice as common in the West and Southwest region as in the North Atlantic region, where only 36 percent of the institutions offered any kind of remedial mathe-

Table 15.--Number and percent of institutions offering prerequisite instruction and percent offering specified courses; by type, control, region, and enrollment size: Aggregate United States, 1960-61

Category of institution	Number of institutions offering prerequisite instruction	Percent offering number in column 2 ÷ number of institutions in category	Percent[1] offering--						
			Plane geometry	Solid geom-etry	Element-ary algebra	Inter-mediate algebra	College algebra	Trigo-nometry	Other courses
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
All institutions.......	508	58	17	10	17	34	4	6	8
Type									
Universities...........	100	72	25	12	29	45	8	10	5
Liberal arts colleges..	308	54	13	8	14	30	4	6	8
Teachers colleges......	82	60	25	19	15	40	1	0	13
Technological schools..	18	56	17	10	22	39	5	12	5
Control									
Public.................	217	74	28	20	28	47	2	4	12
Private................	291	50	11	6	11	27	5	6	6
Region									
North Atlantic.........	92	36	6	2	9	16	5	7	6
Great Lakes and Plains.	168	62	17	9	19	38	4	5	7
Southeast..............	131	66	22	19	19	36	3	3	10
West and Southwest.....	117	76	27	17	24	52	5	8	10
Enrollment size									
Over 5,000.............	111	78	26	11	32	51	9	11	8
1,500-5,000............	135	61	24	16	22	42	4	5	8
700-1,499..............	136	54	12	8	13	30	3	6	5
Under 700..............	126	48	10	7	9	22	3	3	10

[1] Each percent is based on the total number of institutions in each category, not just on the number offering prerequisite instruction.

Table 16.--Percent of institutions giving specified prerequisite courses that also gave college credit for them; by type, control, region, and enrollment size: Aggregate United States, 1960-61

Category of institution	Of those institutions offering the course, percent which gave college credit for:						
	Plane geometry	Solid geometry	Elementary algebra	Intermediate algebra	College algebra	Trigonometry	Other courses
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
All institutions	31	68	36	73	77	58	55
Type							
Universities..........	18	50	35	67	60	54	33
Liberal arts colleges.	29	69	35	74	86	63	59
Teachers colleges.....	53	80	55	92	100	0	59
Technological schools.	14	50	0	31	50	40	0
Control							
Public................	38	70	41	82	50	75	56
Private...............	23	64	30	67	83	53	54
Region							
North Atlantic........	7	50	22	44	58	22	43
Great Lakes and Plains	36	60	42	74	80	67	75
Southeast.............	21	69	24	73	100	60	40
West and Southwest....	44	76	47	87	88	100	60
Enrollment size							
Over 5,000............	19	47	36	66	50	53	46
1,500-5,000...........	33	67	36	76	100	90	65
700-1,499.............	45	86	39	78	75	31	57
Under 700.............	27	67	29	72	100	78	52

matics. The largest institutions, principally the universities, tended to offer prerequisite courses much more than did the smaller institutions. Perhaps the smaller institutions found it more difficult to provide the additional staff for prerequisite instruction.

Intermediate algebra was the subject most frequently given as prerequisite instruction; 34 percent of all 877 responding institutions offered it. Only a small number of colleges and universities offered college algebra or trigonometry as subfreshman courses. About one-sixth of all the institutions gave plane geometry, and about one-sixth gave elementary algebra.

Except for plane geometry and elementary algebra, college credit was given for prerequisite instruction more often than not; only 31 percent and 36 percent of all institutions, respectively, offered credit for these courses. (See table 16.) Teachers colleges tended to give credit more than did other types of institutions; public institutions, more than private institutions; and the West and Southwest region, more than other regions. Although the largest institutions offered prerequisite instruction more frequently than did the smaller institutions, they gave college credit for it less frequently.

Enrollments in Prerequisite Instruction

Table 17 gives the total number of students enrolled in Fall 1960 in courses of prerequisite instruction, in all institutions and in various categories of institutions. The 50,899 students in all institutions represent almost 14 percent of the 374,830 students enrolled in freshman-year mathematics courses in the 877 participating colleges and universities. In other

Table 17.--Number of students enrolled in prerequisite instruction and percent distribution in specified courses in the fall of 1960; by type, control, region, and enrollment size: Aggregate United States

Category of institution	Total enrollment in prerequisite instruction	Percent distribution of total enrollment in prerequisite--						
		Plane geometry	Solid geometry	Elementary algebra	Intermediate algebra	College algebra	Trigonometry	Other subjects.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
All institutions......	50,899	6	3	18	53	5	4	10
Type								
Universities..........	22,382	3	3	20	57	6	6	6
Liberal arts colleges.	19,416	8	3	19	48	6	3	13
Teachers colleges.....	6,394	11	2	12	53	1	0	21
Technological schools.	2,707	15	2	12	57	1	6	7
Control								
Public................	37,641	5	3	19	55	4	4	11
Private...............	13,258	10	3	16	48	9	6	9
Region								
North Atlantic........	6,121	4	1	24	40	9	7	14
Great Lakes and Plains	17,908	8	2	16	58	4	4	9
Southeast.............	10,829	9	5	19	49	1	1	15
West and Southwest....	16,041	4	2	17	55	7	6	8
Enrollment size								
Over 5,000............	28,374	3	1	18	59	6	6	6
1,500-5,000...........	14,206	9	5	19	47	3	3	15
700-1,499.............	5,403	13	2	16	47	4	4	14
Under 700.............	2,916	5	4	14	36	12	2	26

words, about one student in seven was enrolled in a course which the institution regarded as remedial.

Table 17 also shows in percentages the distribution of enrollment in prerequisite courses for each category of institution as well as for all institutions. More than half (53 percent) of the students in all institutions who were taking courses considered subfreshman were enrolled in intermediate algebra. The only other course with a fairly high percentage was elementary algebra (18 percent).

Public institutions had almost three times as many students enrolled in prerequisite instruction as did private institutions. For the most part, private institutions, which can establish higher admissions requirements, do not feel obligated to give such courses. Enrollments in prerequisite instruction were much lower in the North Atlantic region than in other regions. As would be expected, the largest institutions, as a category, had the largest enrollments. Very few teachers colleges offered college algebra or trigonometry as prerequisite instruction. More than one in five students in remedial courses in these colleges were enrolled in mathematics courses other than those specified in the questionnaire--often in basic mathematics or arithmetic.

Where Prerequisite Instruction Is Given

A total of 447 colleges and universities, or 88 percent of the 508 offering prerequisite instruction, offered it as a regular service of the mathematics department. Forty-eight, or 9 percent, provided the service through an extension activity of their institution, and 19, or 4 percent, used other means. A few institutions indicated that they used more than one of these methods. The pattern was similar among the various categories of institution.

Discontinuance of Prerequisite Instruction from 1951 to 1961

A total of 84, or 23 percent, of the 369 institutions which were not at the time of the survey offering prerequisite instruction, had offered it some time in the preceding 10 years. Liberal arts colleges accounted for 77 percent of the institutions that had discontinued it, although they constituted only 66 percent of the responding institutions. On the other hand, teachers colleges contributed only 6 percent of the discontinuances, although they represented 15 percent of the 877 institutions in the survey.

In dropping remedial mathematics, private institutions were 14 percent higher than the percentage they represented of public and private institutions combined, and conversely, the public institutions were 14 percent lower. By the standards applied in this survey, there were no important regional differences. Enrollment size was a controlling factor: the largest institutions, representing only 16 percent of the universe of institutions, constituted 36 percent of those discontinuing remedial instruction, whereas the smallest institutions, representing 30 percent of the universe, made up only 10 percent of those dropping such instruction.

The principal reasons given by respondents for the discontinuance of prerequisite instruction, together with some selected comments, appear below:

1. Better high school preparation

A small private liberal arts school in the East: "1958--Trigonometry, and solid geometry were discontinued. Entering students who are prospective math majors take trig in high school, and a complete course in solid geometry is no longer considered necessary even for prospective teachers."

A very small private liberal arts college in the Southeast: "We have not altogether discontinued this service, but find it hard to fit into schedule. More students offer 2 1/2 years of high-school math."

Another small private liberal arts institution in the Southeast: "Discontinued 3 years ago - insufficient demand."

A fairly large private liberal arts school in the Far West: "Discontinued 1950--No longer necessary. High school preparation adequate."

A small private liberal arts college in the Great Lakes area: "In 1957-58, we had three freshmen who did not offer plane geometry as an entrance unit, so we provided such a course for them. Since that time, prospective students have been told to get it off campus."

2. Staffing problems

A small private liberal arts school in the Great Lakes area: "Discontinued in 1960--shortage in regular staff."

A small public liberal arts college in the Great Lakes area: "Lack of teaching personnel."

A fairly large private liberal arts college in the Southeast: "Staff needed for regular instruction plus decreasing need for courses due to higher entrance standards."

3. Preference for giving remedial help without formal courses

A small private liberal arts school in the East: "Faculty members are quite readily available for help and students are in charge of problem sessions which may be attended voluntarily by those in difficulty."

4. Belief that remedial courses are not a legitimate part of college curriculum

A small private liberal arts college in the North Atlantic area: "When I arrived here in 1953 such courses were being given as regular college credit courses. I junked the whole mess, got new faculty, and put in all new courses by 1955. Of course, college algebra and trigonometry are a part, in a sense, of the Allendoerfer and Oakley text."

A fairly large private liberal arts college in the Great Lakes area: "1958. It was felt that high-school mathematics was improving; also that college professors should not use valuable time for prerequisite instruction."

A fairly large private liberal arts school in the West: "Remedial instruction is being curtailed as rapidly as possible as being wasteful of staff time."

REQUIRED ADMISSIONS EXAMINATIONS THAT INCLUDED MATHEMATICS (ITEM 5)

A total of 657, or 75 percent, of the 877 responding institutions reported that they had an admissions examination which included mathematics (see table 18). The College Entrance Examination Board (C.E.E.B.) test was by far the most commonly used. Of the institutions requiring mathematics examinations for admissions, 57 percent either required the C.E.E.B. test permitted it as one of two or more alternatives. The C.E.E.B. Achievement examination was used by 25 percent of the institutions requiring mathematics examinations for admission; a State examination (mostly New York State Regents Examination), by 6 percent; a local, institutional examination, by 20 percent; and "other" examinations, by 25 percent. The "other" examinations consisted principally of tests

Table 18.--Number and percent of institutions requiring admissions examinations that include mathematics, and percent of usage of different examinations; by type, control, region, and enrollment size: Aggregate United States, 1960-61

Category of institution	Number of institutions requiring such examinations	Percent requiring number in column 2 ÷ number of institutions in category	Percent[1] of institutions in column 2 in which the requirement can be met by:				
			C.E.E.B.[2] Aptitude	C.E.E.B.[2] Achievement	State examination	Institutional examination	Other examination
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
All institutions......	657	75	57	25	6	20	25
Type							
Universities..........	103	75	61	32	7	22	18
Liberal arts colleges.	433	76	61	25	4	17	23
Teachers colleges.....	92	68	32	15	10	28	37
Technological schools.	29	91	59	34	14	24	24
Control							
Public................	192	66	36	18	8	29	32
Private...............	465	79	66	29	5	16	21
Region							
North Atlantic........	229	89	77	39	11	15	11
Great Lakes and Plains	181	67	43	18	1	27	36
Southeast.............	136	69	51	21	6	21	22
West and Southwest....	111	73	46	14	4	16	35
Enrollment size							
Over 5,000............	106	74	50	31	8	24	27
1,500-5,000...........	165	75	52	22	9	25	22
700-1,499.............	202	81	65	27	3	16	22
Under 700.............	184	70	57	23	5	17	27

[1] Some institutions permit more than one examination to meet their admissions requirement. Hence, the percents in columns 4 through 8 add up to more than 100 percent.

[2] College Entrance Examination Board.

issued by the American College Testing Program (ACT), the School and College Ability Test (SCAT), and Sequential Tests of Educational Progress (STEP).

Comparisons by Type of Institution

Technological schools as a group required admissions examinations including mathematics more frequently than any other type of institution, with 91 percent of them requiring them. Teachers colleges, with 68 percent, required them least among the four types of institutions surveyed.

The C.E.E.B. Aptitude examination was by far the most commonly employed test, except in the teachers colleges. Fewer than one-third (32 percent) of the teachers colleges used this test, but teachers colleges were highest in the use of "other" examinations (37 percent) and institutional examinations (28 percent).

Comparisons by Control

Private institutions (79 percent) required admissions examinations involving mathematics more than did public institutions (66 percent). The difference between the private and public institutions in the frequency of use of the C.E.E.B. Aptitude examination was particularly striking. This examination met the requirement in 66 percent of the private institutions, but only in 36 percent of the public ones. Institutional and "other" examinations were more commonly used in public than in private institutions.

Comparisons by Region

The North Atlantic region (89 percent) required admissions examinations involving mathematics far more than did the other three regions, which clustered around 70 percent. The C.E.E.B. Aptitude examination was especially popular in the North Atlantic region, where it met the requirement of 77 percent of the institutions. Because of the New York State Regents examination, the North Atlantic region also led in the use of State examinations (11 percent). The Great Lakes and Plains region was highest in the use of institutional examinations (27 percent) and "other" examinations (36 percent).

Comparisons by Enrollment Size

Institutions with enrollments of 700 to 1,499 students required admissions examinations involving mathematics (81 percent) slightly more than did other size-categories of institutions. The same category also led in requiring or permitting the use of C.E.E.B. Aptitude test (63 percent). Institutional examinations were more commonly used in larger institutions than in smaller ones. Perhaps the larger staffs at larger institutions are helpful factors in the preparation of examinations locally.

PLACEMENT EXAMINATIONS IN MATHEMATICS (ITEM 6)

Because of the diversity of mathematical background and ability among entering freshmen, many institutions administer placement examinations in mathematics. Sometimes these examinations are given to determine, on the basis of the student's knowledge of mathematics, the proper course for him to enter. At other times, they are given to measure the mathematical aptitude of the student or to help divide the students into appropriate course-sections. A list of the various standardized, or nationally distributed, examinations used for placement are shown in the following listing, and the statistical findings on the use of placement examinations generally, in table 15.

Nationally Distributed or Standardized Mathematics Examinations Used for Placement*

The Educational Testing Service Cooperative Series

- The Cooperative Mathematics Pretest for College Students
- The Cooperative High School Mathematics Tests: Elementary Algebra (through quadratics)
- The Cooperative High School Mathematics Tests: Intermediate Algebra (quadratics and beyond)
- The Cooperative High School Mathematics Tests: Plane Trigonometry
- The Cooperative High School Mathematics Tests: Plane Geometry
- The Cooperative General Culture Test, Mathematics Section
- The Cooperative General Achievement Tests: Test 3, Mathematics

The Educational Testing Service, Other Examinations

- College Entrance Examination Board Advanced Placement Program: Mathematics
- College Entrance Examination Board Scholastic Aptitude Test
- Pre-engineering Ability Test
- School and College Ability Tests, Level 1 or Level 2
- Sequential Tests of Educational Progress: Mathematics Section, Level 1 or Level 2

Harcourt, Brace, and World, Inc. Examinations

- Blyth Second-Year Algebra Test
- Davis Test of Functional Competence in Mathematics, Grades 9-13
- Essential High School Content Battery: Mathematics Section, Grades 10-12
- Lankton First-Year Algebra Test
- Madden-Peak Arithmetic Computation Test
- Metropolitan Achievement Tests, Grades 7-9
- Snader General Mathematics Test, Grades 9-13
- Stanford Achievement Test: Arithmetic, Grades 7-9

Other Examinations

- Algebra Prognosis Test—Bobbs Merrill Co., Inc.
- Algebra Test for Engineering and Science—Acorn Publishing Company
- American College Testing Program—Science Research Associates, Inc.
- California Achievement Tests: Mathematics—California Test Bureau
- College Qualification Tests—Numerical—The Psychological Corporation
- Differential Aptitude Test—Numerical Ability—The Psychological Corporation

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*Does not include psychological examinations per se by colleges or the armed services. Also, some of the examinations indicated on the questionnaire were unclassifiable.

Table 10.--Number and percent of institutions administering a placement examination in mathematics, and percents related to pertinent characteristics of these examinations; by type, control, region, and enrollment size: Aggregate United States, 1960-61

Category of institution	Institutions administering placement examinations		Percent of institutions administering placement exams which use standardized or nationally distributed exams	Percent[1] of institutions at which placement examinations are taken by--				Percent[1] of institutions at which placement examination tests for knowledge of--				Percent[1] of institutions at which the objective of the placement exam is to--				
	Number	Percent		All entering freshmen	Students taking math in college for first time	Students in special curriculums only	Other	Algebra	Geometry	Trigonometry	Other	Determine math knowledge of students	Determine math aptitude of students	Section students into equal ability levels	Determine specific course for student to enter	Other
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
All institutions	517	78	61	56	27	14	12	88	50	49	20	58	26	24	70	6
Type																
Universities	106	72	62	67	23	26	20	92	51	68	15	58	16	17	79	7
Liberal arts colleges	312	80	63	56	31	12	10	90	50	44	20	57	28	26	70	5
Teachers colleges	81	80	70	37	33	7	10	77	48	40	30	60	26	25	60	10
Technological schools	17	73	67	71	18	6	18	82	35	41	18	71	41	12	47	0
Control																
Public	207	71	62	56	26	22	12	85	43	48	30	63	19	21	69	7
Private	311	82	60	53	33	10	13	90	56	50	14	55	30	25	70	5
Region																
North Atlantic	112	86	60	61	26	17	13	82	57	60	23	45	27	21	61	11
Great Lakes and Plains	167	80	70	71	36	11	12	88	51	57	20	55	23	26	75	7
Southeast	148	80	74	48	26	11	10	91	45	31	18	65	29	31	67	2
West and Southwest	106	80	60	56	33	20	16	91	46	50	20	70	24	13	75	3
Enrollment size																
Over 5,000	119	73	63	67	22	27	20	93	47	69	33	61	12	17	78	9
1,000-5,000	168	86	63	71	30	17	11	90	48	45	18	62	25	25	66	3
500-1,000	148	76	63	53	32	9	10	88	55	46	19	54	24	25	68	3
Under 500	131	80	58	63	31	6	11	80	47	42	14	57	39	23	66	8

[1] Totals do not add up to 100 because more than one item could be checked by a respondent.

Engineering and Physical Science Aptitude Test--The Psychological Corporation

Iowa Placement Examinations: Mathematics Aptitude, Grades 12-13--Bureau of Educational Research and Service, State University of Iowa

Iowa Placement Examinations: Mathematics Training, Grades 12-13--Bureau of Educational Research and Service, State University of Iowa

Kansas Mathematics Test, Grades 9-13--Kansas State Teachers College

Kentucky Classification Battery, Grades 12 and 13--Kentucky Cooperative Counseling and Testing Service

The Purdue Mathematics Training Test: Arithmetic and Algebra, Grade 13--University Book Store, West Lafayette, Indiana

Statistical Findings

All institutions.--A total of 517 institutions, or 59 percent of all respondents, reported administering a mathematics placement examination. Of these institutions, more than half (54 percent) administered them to all entering freshmen. Twenty-nine percent administered them only to students taking mathematics in college for the first time, and 14 percent only to students in such special curriculums as engineering. Algebra (88 percent) is the subject most commonly tested for, and geometry and trigonometry next, with about half the institutions testing for the former and half for the latter. The most common objective was to determine the specific course in which to enroll the student. Seventy percent of the institutions used the placement examination for this purpose, while 58 percent used it to discover the mathematical knowledge of the student.

Principal differences, by category of institution.--Three-fourths of the universities, but only slightly more than half the liberal arts colleges or technological schools, required placement examinations. Among institutions that administered such examinations, technological schools required them most frequently (71 percent) of all entering freshmen, and universities required them most frequently (28 percent) for students taking special curriculums.

Public institutions required placement examinations much more (71 percent) than did private institutions (53 percent). The latter were more prone to require them for students taking mathematics in college for the first time (33 percent to 24 percent), but less prone to require them only of students in special curriculums (10 percent to 22 percent).

Institutions in the North Atlantic region required placement examinations less often (44 percent) than did institutions in other regions of the country. They were also lowest in the percentage (41 percent) requiring such examinations of all entering freshmen.

The percentage of institutions requiring placement examinations varied directly according to size, ranging from 73 percent for institutions with enrollments of more than 5,000 down to 50 percent for institutions with enrollments of less than 700. There was an inverse relationship, however, between the size category of institutions and the percentage requiring placement examinations for all entering freshmen, with the range extending from 47 percent to 63 percent.

PROGRAMS OF ADVANCED STANDING IN MATHEMATICS (ITEM 8)

In recent years there has been increasing interest in programs of advanced standing in colleges and universities. Factors contributing to the growth of such programs include (1) the introduction, by some of the better high schools, of some work of college grade in the senior year; (2) the recognition by many educators that repetition in college of work taken in high school is wasteful of a student's time; and (3) burgeoning college enrollments, which are putting heavy strains on college and university staffs and facilities.

As used in this report, "advanced standing" refers to a program whereby a college or university permits a student to receive appropriate placement, with or without credit, on the basis of college-level courses taken in high school. It must be remembered, however, that because of differing standards, what is considered to be of college level in one institution may not be so regarded in another. The statistical findings on advanced standing are shown in table 20.

Table 20.--Number and percent of institutions with programs of advanced standing in mathematics, extent to which credit is given for courses skipped, and factors upon which advanced standing is based; by type, control, region, and enrollment size: Aggregate United States, 1960-61

Category of institution	Number of institutions having such programs	Percent having (column 2 ÷ all institutions in category)	Institutions giving college credit for courses skipped		Percent[1] of institutions in column 4 giving course credits in--					Percent[2] of institutions in column 2 basing advanced standing on--			
					College algebra	Trigonometry	Analytic geometry	Calculus	Other	Recommendation of high school	Locally constructed proficiency examination	Nationally distributed proficiency examination	Other
	Number	Percent	Number	Percent									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
All institutions.......	589	67	310	53	55	54	52	51	14	20	48	37	17
Type													
Universities............	125	90	92	74	51	50	55	65	5	13	62	43	10
Liberal arts colleges..	388	68	181	47	55	54	53	46	17	22	45	36	18
Teachers colleges......	60	44	28	47	75	68	39	36	25	22	40	20	20
Technological schools..	6	50	9	56	33	44	44	56	11	38	31	63	25
Control													
Public.................	180	62	113	63	65	65	50	50	15	12	54	26	16
Private................	409	70	197	48	49	47	54	52	13	24	45	41	17
Region													
North Atlantic.........	171	67	90	53	29	28	57	72	19	25	29	57	16
Great Lakes and Plains.	196	73	113	58	56	56	55	49	14	18	53	33	17
Southeast..............	118	60	56	47	84	80	43	27	9	19	58	19	22
West and Southwest.....	104	68	51	49	69	65	49	47	10	19	56	29	13
Enrollment size													
Over 5,000.............	124	87	92	74	53	53	63	66	8	11	61	44	13
1,500-5,000............	153	69	74	48	55	53	53	53	14	20	44	34	17
700-1,499..............	166	66	87	52	49	47	46	47	18	23	46	38	16
Under 700..............	146	56	77	39	67	65	44	32	18	25	40	31	22

[1] The sum of the percents exceeds 100 percent, since many colleges give advanced standing credit for more than one kind of mathematics course.
[2] The sum of the percents exceeds 100 percent, since many colleges base advanced standing on more than one method.

Institutions differ greatly in their policies on advanced placement. Some that grant placement in an advanced course give credit for the prerequisite and some do not. Some give credit for one semester of the freshman course or credit for a parallel course. Some award credit toward the general education requirements or merely grant exemption from them without giving credit. Some set a limit on the amount of credit awarded, and some give unlimited credit.

Of the 877 institutions reporting in the survey, 589, or 67 percent, had programs of advanced standing. Of these, 310, or 53 percent, gave credit for courses for which students had already met the requirements through previous study. Fifty-five percent of these 310 gave credit for college algebra in such instances; 54 percent, for trigonometry; 52 percent, for analytic geometry; 51 percent, for calculus; and 14 percent, for some other subject.

Twenty percent of the institutions having programs of advanced standing admitted students to these programs on the basis of the recommendations of the high school; 48 percent, on the basis of a proficiency examination constructed locally; 37 percent, on the basis of a nationally distributed proficiency examination; and 17 percent, by some other measure. As is apparent from the total of the preceding percentages, a number of institutions used more than one of these means.

Comparisons by Type of Institution

Ninety percent of the universities offered programs of advanced standing, but only 44 percent of the teachers colleges did. Universities took the lead in giving college credit for courses skipped. Seventy-four percent of them gave such credit, as compared to 47 percent of both liberal arts and teachers colleges.

Universities tended to give credit for analytic geometry and calculus more than for college algebra, trigonometry, or any other mathematics subject; liberal arts colleges, for college algebra, trigonometry, and analytic geometry more than for calculus or any other mathematics subject; teachers colleges, for college algebra and trigonometry more than for any other mathematics subject; and technological schools, for calculus more than any other mathematics subject.

The type of institution also seemed to have some bearing on the means used to determine advanced standing, although again it is important to remember that institutions frequently used more than one means. Universities seemed to base advanced standing on proficiency examinations more frequently than on other means, particularly locally constructed exams, but also on nationally distributed ones; the percentages of universities using each were 62 percent and 43 percent, respectively. Only 13 percent relied on the recommendation of the high school; and 10 percent, on some other measure.

Liberal arts colleges, like universities, relied more on proficiency examinations: 45 percent based advanced standing on locally constructed examinations; and 36 percent, on nationally distributed ones. They tended more than universities but less than technological schools to rely on the recommendation of the high school.

Forty percent of the teachers colleges based advanced standing upon a locally constructed proficiency examination. Approximately 22 percent accepted the recommendation of the high school; 20 percent, a national proficiency examination; and 20 percent, some other measure.

Technological schools favored national proficiency examinations, which were used to measure eligibility for advanced standing in 63 percent of the schools. Thirty-eight percent allowed advanced standing on the basis of high school recommendations; 31 percent, on a locally constructed proficiency test; and 25 percent, on some other measure.

Comparisons by Control

A slightly higher percentage of privately controlled institutions had programs of advanced standing than did publicly controlled schools. Among the private institutions 409, or 70 percent, had such programs as compared with 180, or 62 percent, of the public colleges. Public institutions with programs of advanced standing, however, were more prone to give college credit for courses skipped, with 63 percent doing so, as compared with 48 percent of private colleges.

Type of administrative control seemed not to have any significant effect on the kinds of courses for which credit was given, except that credit was granted for college algebra and trigonometry more frequently in public institutions than in private ones. This difference is due principally to the southern colleges, which are mostly public institutions.

In determining advanced standing, public institutions used locally constructed proficiency examinations more often than any other means; and private institutions used both locally constructed and national examinations about equally.

Comparisons by Region

A slightly higher proportion of schools in the Great Lakes and Plains region both offered programs of advanced standing and also gave college credit for courses skipped. One hundred ninety-six, or 73 percent, of the institutions in the Great Lakes and plains region had programs of advanced standing; 104, or 68 percent, in the West and Southwest region; 171, or 67 percent, in the North Atlantic region; and 118, or 60 percent, in the Southeast region.

Of the institutions having programs of advanced standing, 58 percent of those in the Great Lakes and Plains region gave college credit for courses skipped; 53 percent, in the North Atlantic region; 49 percent, in the West and Southwest region; and 47 percent, in the Southeast region.

A large percentage of institutions in the Southeast region gave college credit for college algebra and trigonometry, whereas a very small percentage of colleges in the North Atlantic region did so. In contrast, an extremely high percentage (72 percent) of institutions in the North Atlantic region gave credit for calculus, compared with only 27 percent in the Southeast region.

There was some regional variation in the emphasis put on particular measures of advanced standing. Whereas a national proficiency examination was by far the most common means of determining advanced standing in the North Atlantic region (57 percent), the locally constructed examination was by far the most common in each of the other three regions.

Comparisons by Enrollment Size

The enrollment sizes of institutions seemed to have some bearing on their advanced standing policies. For example, a much larger percentage of institutions with enrollments of more than 5,000 had programs of advanced standing and also gave credit for courses skipped than did institutions with smaller enrollments. Institutions with fewer than 700 students had the smallest proportion of programs of advanced standing.

Institutions with fewer than 700 students gave credit for college algebra and trigonometry more commonly than did institutions of any other size. On the other hand, the percentage of institutions giving credit in analytic geometry and calculus followed the order of enrollment size from high to low.

The largest proportion of institutions, regardless of size of enrollment, used a locally constructed proficiency examination, the second most popular measure being an examination made up by a national agency. In addition, institutions with more than 5,000 students based advanced standing on high school recommendation less frequently than did institutions of any other size category.

UNDERGRADUATE HONORS PROGRAMS IN MATHEMATICS (ITEM 7)

More and more emphasis has been placed by colleges and universities in recent years on programs specially designed for undergraduates of superior ability. This increased emphasis has resulted from several factors: (1) the complaint during the 1950's that the failure of many colleges to challenge the gifted was wasteful, both to the individuals concerned and to the Nation; (2) a greater interest, especially since the launching of Sputnik in 1957, in nurturing to the full the talents of superior students; and (3) the expanding enrollments in most colleges and universities, making it more feasible economically to provide special sections.

Statistical Findings

A total of 266 (30 percent) of the 877 respondents in the survey indicated that they had an honors program. A breakdown of the 266 by type of institution shows that 60 percent of the universities, 27 percent of the liberal arts colleges, 13 percent of the teachers colleges, and 16 percent of the technological institutes offered a special program. An analysis by public versus private control shows almost no difference: 31 to 30 percent, respectively. Regional differences do not seem great, either. In both the North Atlantic region and the Great Lakes and Plains region, about 34 percent of the reporting institutions offered such a program; in the Southeast, 26 percent; and in the West and Southwest, 25 percent. Size of institution seemed a very important factor, since 57 percent of the largest institutions (more than 5,000 students) offered an honors program, whereas only 17 percent of the smallest institutions (fewer than 700 students) did so. Among institutions with enrollments between 1,500 and 5,000, 30 percent offered special programs; among those with enrollments between 700 and 1,499, 29 percent offered them.

Types of Program

The most popular program consisted of independent study culminating usually in an honors thesis. The offering of special courses open only to honors students and not part of their regular mathematics program was next in popularity. Many institutions offered accelerated courses in which the gifted would go faster and do more work than the others. These types of programs were offered, respectively, by 43 percent, 12 percent, and 11 percent of those institutions with special programs.

In addition, there were programs in which the student was given directed reading, programs consisting of seminars with special research projects and reports, and programs which permitted and encouraged the gifted undergraduate to take graduate courses. Many programs which do not require a thesis require an oral examination, occasionally by outside examiners.

Independent study.--There were enough institutions with programs of independent study to make a breakdown by categories. While this type of program was very popular among liberal arts institutions (90 schools, or 57 percent of those offering honors programs, offered this kind), it was less popular among other types of institutions. Only 38 percent of the teacher's colleges with honors programs offered independent study programs, 21 percent of the universities, and no technological institutes.

The independent study method was practiced at 50 percent of the private institutions with special programs for the superior undergraduate student, but at only 30 percent of the public institutions. Independent study seemed to be the predominant form of program for the superior student at the smaller colleges, being offered by 60 percent of the schools with enrollments between 700 and 1,500 and 62 percent of those with enrollments of fewer than 700. On the other hand, the corresponding percentages were only 22 percent for schools with enrollments of more than 5,000 and 36 percent for schools with enrollments between 1,500 and 5,000.

There were few regional differences: North Atlantic, 49 percent; Great Lakes and Plains, 43 percent; Southeast, 49 percent. Only the West and Southwest region showed great variation, with only 21 percent of its schools offering this particular form of honors program.

The data on the other programs are insufficient for detailed statistical analysis. The available data suggest that the largest schools--those with enrollments of more than 5,000--usually universities, make the most use both of special courses and special sections. Beyond this it is impossible to generalize.

Admission Criteria

The usual criteria for entry into an honors program in the freshman year were the high school record and scores on placement examinations and on various ability tests. For those entering honors programs later in the college career, class standing and records in college mathematics were the usual criteria.

General Observations

Honors programs in mathematics were usually part of a college-wide honors program. Although only 30 percent of the colleges indicated having such programs, many others reported that they were considering or were about to establish one.

At present, special or honors programs seem to be concentrated in the large public universities, where the wide spread of abilities and background makes a diversity of programs necessary and where the large number of students makes an extensive honors program possible. That the typical honors program at these institutions consists of special sections or classes seems to reflect the large number of students eligible for the program and possibly a student-teacher ratio which precludes a program of independent study at reasonable cost. Similarly, the prevalence of independent study programs at liberal arts colleges might be indicative of the small number of eligible students and of a more favorable student-teacher ratio.

A number of colleges and universities have devoted considerable attention to developing special programs in mathematics for undergraduate students, such as the following examples:

The Program at Carleton College

Carleton College, a coeducational college in Northfield, Minn., with fewer than 1,300 students, has been experimenting with programs for superior undergraduate mathematics students for a number of years. A program in effect during the period 1955-59, and another being conducted during the period 1961-65, will be described here. Both programs have received support from the National Science Foundation.

Program during 1955-59.[2]--The program for gifted students centered around honors sections in the freshman and sophomore years and a "colloquium" for advanced students. Students with unusual promise in mathematics (as shown chiefly by scores in both the verbal and mathematical aptitude tests of the College Entrance Examination Board) were invited to enroll in a 2-year honors section.

The usual freshman-sophomore sequence in mathematics starts with an introduction to logic, set theory, and other notions fundamental to modern mathematics, and proceeds to a course in the calculus through manipulative differential equations and the calculus of several variables. Using the same textbooks, the honors section covered this material with considerable enrichment in three semesters instead of four. The second semester of the sophomore year was devoted to projects chosen by the class.

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[2] See also Kenneth O. May, "Undergraduate Research in Mathematics," The American Mathematical Monthly, Vol. LXV, No. 4, April 1958, p. 241-46.

Because the honors students could quickly master definitions and techniques, it was found undesirable to spend much class time on routine matters or on drill. Rather, the emphasis was on creativity, even through grading. Merely learning definitions, theorems, and skills did not earn a high grade. The grade B depended to some extent, and the A primarily, on evidence of originality and initiative. Memory and recall earned C's, whereas A was the scholar's grade. This is consistent with the practice in the English departments, where a student gets A for a theme only if, in addition to being free of grammatical and spelling errors, it shows evidence of independent thinking. The average grade in an honors section was expected to be between an A and a B, usually with more A's than B's being assigned. Students who did not maintain this standard were asked to transfer to a regular section.

The honors sections were conducted on an informal basis. Some time was taken for lectures introducing supplementary subject matter, but most of the class time was devoted to students exposition of their best work and to discussion of difficult problems. Students were told that they would be permitted to hand in one problem a week of their own choice, which might be from the part of the book currently being discussed, from previous or future problem sets, or from any other source. In any case the student was to select the problem which, in his opinion, represented his best work for the week. It was pointed out to the class that this manner of judging people is similar to the way in which scientists are judged by their colleagues, namely in terms of their best work.

Honors students were expected to engage in research activities. These varied from solving difficult problems, such as those given in the Putnam Competition (a national annual, competitive examination for undergraduate mathematics students) to carrying on a long-term project. There was no concern for whether results were publishable, because, it was felt, the student who obtains previously published results by doing work original for him, gains as valuable an experience as if the work had never been done before.

Research assistants were chosen informally by the entire staff on the basis of demonstrated interest and ability. Assistantships were awarded to nonmajors with the necessary interest and qualifications. Assistants were paid stipends, the amounts dependings on financial need and amount of service rendered.

Approximately once a week, the mathematics staff and research assistants met informally in a room equipped with comfortable chairs and a blackboard. The programs at the colloquia were varied: an introduction to some research problem, a report on research activities, an expository talk by a visiting mathematician, a joint discussion of a paper or book that had been read by the group, or a cooperative attack on a problem. Participation in the colloquium was open to all interested students and faculty at Carleton College and at neighboring St. Olaf College.

This entire program was costly in time, since staff members needed time to prepare for individual students, to confer with them, and to help them undertake original work. In working with honors students, it was considered important for faculty members to work with smaller sections. The grant from the National Science Foundation permitted the addition of one full-time person for this purpose. This allowed two extra sections of freshman and sophomore mathematics and a reduction of teaching load equal to half a full-time load, which was distributed among the entire staff since all staff members were expected to participate in the program.

Program for 1961-63.--In 1961 the program was revised to provide greater economic efficiency. Although the program of 1955-59 was in general quite successful, it could not be sustained without continued outside financial support. The honors sections were somewhat inefficient because of errors in selection and the necessity of spending a large proportion of the time in duplicating activities of the regular sections. The program of 1961-63, also receiving support by a grant from the National Science Foundation, was developed to test the hypothesis that the desired results could be achieved without honors sections by utilizing colloquia and a local journal at all levels. The program is designed for able students taking many credits in mathematics, usually as many as are consistent with a liberal arts degree.

In 1961-62, colloquia were held separately for freshmen, for sophomores, and for juniors and seniors. As a result of the experience gained during that year, the colloquia for freshmen and for sophomores were combined into one colloquium for both freshmen and sophomores.

An informal journal, called Delta-Epsilon, commenced publication in 1961-62. It has no regular dates of publication, but whenever a few pages of student work are produced, they are typed and duplicated. The journal contains honors problems, problems of the month, interesting student papers from classes at all levels, reports on research projects, news of graduates, and anything else that deserves circulation. It is sent free to majors and others who request it. It has been very helpful as a stimulus and means of recognition.[3]

The Program at Wesleyan University

Wesleyan University, at Middletown, Conn., has embarked on a series of experiments to strengthen the impact of liberal education on undergraduates. If the experiments prove sound, the institution is to be divided into groups of "colleges." The colleges are only incidentally and marginally social units; the students enter a college as sophomores and are united principally in their intellectual goals. Most important, the colleges are designed to promote unity of students and faculty in a common enterprise. Thus, the students in a college are under the jurisdiction of a tutorial committee, which maps out a meaningful program of study for each student, and determines when he is to be recommended for a degree. Much of the traditional apparatus of the American university is abandoned--specific requirements (in terms of courses passed), the accumulation of "credits" in a recorder's books, and frequent quizzes, tests, and examinations.

Two examinations, a Junior Qualifying Examination and a Senior Comprehensive Examination, are prepared by outside examiners; the college faculty are not inquisitors, but rather preceptors, instructors, and older colleagues. The examinations cover all three aspects of the student's experience--his core program, the central part of his major study; his supplementary program, study related to the core; and the generalizations, subjects of interest to the student, outside the range of his specialization.

Two college-plan experiments began in 1959: a College of Letters and a College of Public Affairs. A College of Quantitative Studies, involving mathematics, began in 1960. It is being run according to the following three guidelines:

(a) Students are introduced to "real" as contrasted with "text-book" problems early in their careers, and their study is keyed to the solution of such problems. Problems are taken from many academic disciplines--from economics, government, psychology, sociology, and biology, as well as from disciplines with a longer history of use of mathematical techniques--and from business, industry, and government.

(b) Summers are used in (small or large) part to continue study, to prepare for the next year, and to work on projects. A change of pace from the academic year is considered essential. Through acceleration, a student can earn an M.S. degree with 4 years beyond high school.

(c) The students usually participate in the teaching of others through freshman problem sessions, machine programing, the symposium, and similar activities.

The College of Quantitative Studies is supervised by directors of studies, representing economics, administration, astronomy, geology and mathematics. Among their other duties, the directors recommend students to the Wesleyan faculty for a B.A. degree. The directors are assisted by faculty members from various departments as needed. In addition, six distinguished men from business, industry, the arts, and scientific research are associated with the college as fellows. They occasionally participate in the discussions, seminars, and social affairs of the college.

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[3] For further information on undergraduate research in mathematics, see Undergraduate Research in Mathematics (Report of a conference held at Carleton College, June 19 to 21, 1961, with support from the National Science Foundation, edited by Kenneth O. May and Seymour Schuster, Carleton Duplicating Service, Northfield, Minn., 1962.)

Students are selected on the basis of strength of interest rather than high native ability. In 1960, there were a few juniors and seniors, along with 20 sophomores. In each of the next 2 years, 20 sophomores were added; a 5-year experiment will thus have been completed when the last group has graduated.

The core program consists of 5 one-semester courses in mathematics. Usually these courses are:

(a) Third-semester calculus
(b) Finite mathematics--logic and sets, probability, vectors and matrices, with applications
(c) Differential equations and related topics
(d) Numerical analysis I
(e) Numerical analysis II

Other courses in mathematics may replace some of these courses if the ability and interest of a particular student warrant a substitution.

The supplementary program consists of approximately four semesters of related coursework (e.g., economics, psychology, or more mathematics), four semesters of "problem work," and two semesters of a "project."

Thus, the core and supplementary programs together amount roughly to the equivalent of 15 semester-courses during the 3-year period, out of a total of about 25 courses. Hence, 60 percent of the student's time is devoted to these two programs, and about 40 percent is left for generalization.

As part of the generalization work, students are expected to participate in a symposium during their sophomore and senior years: an interdivisional reading course, with students and faculty from other colleges representing different disciplines. There are common readings on a central theme designed to prepare the student to continue to read comparable materials after graduation.

Although students are expected to follow generally the program outlined here, the directors of studies have great freedom in making allowances for individual differences.

The Program at Dartmouth College

At Dartmouth College, Hanover, N.H., the basic sequence in mathematics for the first 2 years consists of two semesters of calculus, followed by a specially designed introduction to modern mathematics, which leads to a course in multivariate calculus. The student is exposed in the freshman year to differentiation, series, and differential equations, and in the second year to an introduction to logic, probability theory, linear algebra, and a modern treatment of vector calculus. Students with a special interest and aptitude for mathematics, who do not need to be drilled in routine matters, are placed in honors sections of these four courses, where a much deeper theoretical understanding of the subject matter is possible. The emphasis in the first 2 years of the honors program is on depth of understanding, not acceleration. Students entering with advanced training may be placed in honors sections, a sophomore course, or a special advanced-placement course. A special two-semester sequence enables students in the biological and social sciences to absorb the basic ideas of the 2-year program, and to see them illustrated in their own area of interest.

There are two mathematics major programs at Dartmouth. The honors major is designed for students contemplating graduate work in mathematics. Such students complete several graduate-level courses in their junior and senior years. Advanced courses are offered in algebra, algebraic geometry, analysis, geometry, logic, numerical analysis, probability theory, statistics, and topology, as well as applications to the physical and social sciences. The major is enriched by a departmental reading program, aiming for breadth in the junior year and for depth in the senior year. Honors seniors write a thesis in an area of special interest to them, working closely with a member of the faculty.

The Program at the University of Maryland

The mathematics honors program at the University of Maryland began in 1939-40. Its purpose is to discover the mathematically gifted undergraduates and to develop their ability in mathematics as fully as possible. Starting in the winter of each year, a concerted drive is made in the high schools of the State to recruit outstanding mathematics students. Although most students who complete the entire program are mathematics majors, the program is not restricted to them. As an aid to recruitment, four $500 scholarships are awarded by the Business Associates of the University of Maryland for academic excellence to freshmen or sophomores from the State of Maryland having exceptional ability and interest in mathematics. Following is a brief description of the program:

(a) Discovery of candidates: Candidates among the University of Maryland freshmen are located by recommendations from high school teachers and/or by scores on the placement examinations. Non-freshman candidates are recommended by the faculty.

(b) Selection of participants: Participants are chosen by the departmental honors committee from among students who show exceptional ability and interest in mathematics. A student may be invited to enter the honors program at any time, on or before the beginning of his senior year.

(c) Participants: Participants are candidates for honors programs of the College of Arts and Sciences. All regulations and privileges of the honors program of the college apply to participants in the mathematics honors program. The participants remain under the continual observation of the departmental honors committee. Those who do not progress satisfactorily are returned to the regular program.

(d) Honors program (Phase I): Students entering the program in their first semester take a special three-semester course (5 hours per week) with a senior member of the faculty. This course covers the material of the regular freshman and sophomore course, but its main aim is to develop the mathematical maturity of the students as quickly as possible. Emphasis is placed on modern concepts and rigor. Independent work is encouraged.

(e) Honors program (Phase II): During the fourth, fifth, and sixth semesters the students normally take 14 hours of advanced undergraduate courses in mathematics. Wherever possible, the honors students are placed in special sections. Independent work is encouraged during both the summer and the school year. This may be done in place of formal courses (under the approval of the honors committee). A weekly seminar is held during the summer and the school year.

(f) Honors program (Phase III): The senior year is devoted to advanced undergraduate courses, graduate-level courses (courses which, except for students in this program, are not open to undergraduates), seminars, independent study, and preparation for written and oral final honors comprehensive examinations in mathematics. This work normally carries 12 hours of credit. Recommendation for graduation with honors, no honors, or high honors in mathematics is made by the departmental honors committee after review of the student's record and the results of the final honors comprehensive examinations.

UNDERGRADUATE THESIS REQUIREMENTS (ITEM 11)

Table 21 gives data on the requirement of mathematics theses by undergraduates. A total of 142, or 16 percent of all the institutions in the survey, required an undergraduate thesis in mathematics for some or all mathematics majors. Fifty-five percent of the 142 required it for honors students only; 40 percent, for all mathematics students; and 5 percent, for other types of students.

Comparisons by Category of Institution

The type of institution seemed to have some bearing on thesis requirements. Liberal arts colleges as a type required an undergraduate thesis more frequently and teachers colleges less frequently than other types of institutions.

Table 21.--Number and percent of institutions which require undergraduate theses of at least some mathematics majors, and percent requiring them of specified categories of students; by type, control, region, and enrollment size: Aggregate United States, 1960-61

Category of institution	Number of institutions requiring undergraduate theses	Percent requiring (number in column 2 ÷ number of institutions in category)	Percent of institutions in column 2 which require undergraduate theses of:		
			All mathematics majors	Honors Students only	Other types of students
(1)	(2)	(3)	(4)	(5)	(6)
All institutions......	142	16	40	55	5
Type					
Universities..........	21	15	19	71	10
Liberal arts college..	112	20	43	54	3
Teachers colleges.....	3	2	50	50	0
Technological schools.	6	19	33	50	17
Control					
Public................	20	7	26	63	11
Private...............	122	21	42	54	4
Region					
North Atlantic........	61	24	41	56	3
Great Lakes and Plains	45	17	40	53	7
Southeast.............	26	13	27	69	4
West and Southwest....	10	7	22	67	11
Enrollment size					
Over 5,000............	16	11	27	67	6
1,500-5,000...........	32	14	25	72	3
700-1,499.............	52	21	39	57	4
Under 700.............	42	16	56	37	7

Both universities and liberal arts colleges required the thesis more of honors students only than they did of all mathematics majors. However, the difference in the percent was much greater in the case of the universities, varying between 71 percent and 19 percent, respectively. The number of teachers colleges (3) and the number of technological institutions (6) requiring undergraduate theses were too small to provide meaningful percentage breakdowns on types of students of whom theses were required.

Private institutions (21 percent) required theses much more often than did public institutions (7 percent). In the public institutions the requirement applicable to honors students only (63 percent) far exceeded that for all mathematics majors (26 percent). The comparable difference amounted to only 12 percent among the liberal arts colleges.

The North Atlantic region was way ahead in the requirement of undergraduate theses in mathematics, 24 percent of all institutions in this region having this requirement. At the other extreme, only 7 percent of the institutions in the West and Southwest region had this requirement. In all four regions, the percentage of schools maintaining this requirement only for honors students exceeded the percentage maintaining it for all mathematics majors, the difference between the two percentages being greatest in the West and Southwest region.

Institutions in the size category of 700 to 1,499 students were more likely (21 percent) to have undergraduate thesis requirements than other size categories of institutions. Of institutions of all types, control, region, and enrollment size, only those with enrollments of fewer than 700 students required the thesis more of all mathematics majors (56 percent) than they did of honors students only (37 percent). The institutions with largest enrollments more frequently limited thesis requirements to honors students only, perhaps because reading theses for all students would be an impossible staff task.

A COLLEGE-LEVEL MATHEMATICS COURSE AS A GRADUATION REQUIREMENT (ITEM 10)

Many academic institutions, as part of their programs of general education, require all students to take at least one mathematics course of college level. The survey revealed that 292 of the 877 participating institutions, or 33 percent, had such a requirement.[4] A larger percentage of public institutions (44 percent) than of private institutions (28 percent) had such a requirement.

Further analysis revealed that the incidence of such a requirement was much lower at universities (22 percent) and liberal arts colleges (29 percent) than at teachers colleges (52 percent) and technological institutions (78 percent). Similarly, striking categorical differences appeared in the regional breakdown; in the North Atlantic and Southeastern regions, relatively high percentages of institutions had such prerequisites (59 percent and 43 percent, respectively and in the Great Lakes and Plains and the West and Southwest regions, relatively small percentages (only 29 percent and 24 percent, respectively).

Size of institution, by contrast, had relatively little bearing on the presence or absence of this requirement. Percentages for institutions of different sizes, from largest to smallest enrollment-size categories, were 37 percent, 30 percent, 39 percent, and 26 percent, respectively.

Most likely, the high percentage of teachers colleges having such a requirement is due to the necessity for many graduates of these schools to teach a course in mathematics at some point in their career; the reason for the high percentage among technological schools, of course, is that mathematics is an integral part of any technical background.

The regional breakdown is somewhat more difficult to explain. Perhaps the greater concentration of industry in the East and thus a greater emphasis on technology accounts for the predominance of required mathematics there. This very tentative hypothesis, however, is perhaps more than the data justify.

INNOVATIONS IN MATHEMATICS PROGRAMS FROM 1950 to 1961 (ITEM 17)

Among the innovations cited on the questionnaire, the most commonly adopted was the substantial expansion of course offerings, a step taken at 517 of the 877 responding institutions, or 59 percent. (See table 22.) Next most frequent was the introduction of more modern freshman courses, an innovation carried out by 409 schools, or 47 percent. The change in, or introduction of, a program for the undergraduate preparation of mathematics teachers was adopted by 317 schools, or 36 percent, over this 10-year period.

The other innovations were somewhat less prevalent. Some were infrequent simply because the practices had already been in existence. For example, only 30 percent of all institutions reported having introduced a program of advanced standing since 1950. Yet 67 percent reported the existence of such programs, indicating that 37 percent of the institutions had already had these prior to 1950.

Least commonplace was the provision of courses in data processing and computing, which were offered by only 149 institutions, or 17 percent of the participating schools. It must be realized, however, that the respondents in this survey were mathematics department heads and that, in some institutions where computing departments have been established, data on these departments may not have been reported.

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[4] A sizable number of institutions reported that, although they had no express requirement for a course in mathematics, they had had a requirement that could be filled by two or more alternatives one of which was mathematics. A rather common requirement was a choice between mathematics or philosophy and logic.

Table 22.--Percent of institutions making specified innovations in undergraduate mathematics programs between 1950 and 1961; by type, control, region, and enrollment size: Aggregate United States

Code:

A. New degree programs

B. Substantially expanded course offerings

C. New freshman courses emphasizing such concepts as structure, logic, set theory, etc.

D. New courses for biological and social science majors

E. New programs, or substantially altered programs, for the undergraduate preparation of mathematics teachers

F. New courses and instruction leading to careers in data processing and computing

G. New honors program

H. New advanced standing program

Category of institution	Percent of institutions introducing innovations							
	A	B	C	D	E	F	G	H
All institutions.........	22	59	47	24	36	17	18	30
Type								
Universities.............	30	71	32	40	39	42	42	45
Liberal arts colleges....	18	55	53	21	33	12	14	28
Teachers colleges........	26	65	43	18	53	7	13	19
Technological schools....	31	53	13	13	6	44	16	22
Control								
Public...................	30	67	46	25	47	23	23	28
Private..................	17	55	47	23	31	14	16	31
Region								
North Atlantic...........	23	59	52	26	34	16	20	32
Great Lakes and Plains...	17	57	48	23	39	15	21	31
Southeast................	19	55	23	23	32	14	14	25
West and Southwest.......	32	67	20	21	41	26	16	29
Enrollment size								
Over 5,000...............	27	69	52	34	36	41	41	45
1,500-5,000..............	29	68	50	26	41	21	20	31
700-1,499................	17	57	47	22	37	12	14	30
Under 700................	17	47	40	17	31	6	8	20

Comparisons by Type of Institution

Universities made innovations in their mathematics programs more than did any other type of institution. They were highest percentagewise in the substantial expansion of course offerings (71 percent); in the provision of new mathematics courses for biology and social science majors (40 percent); in the introduction of honors programs (42 percent); and in the introduction of programs of advanced standing (45 percent). The universities also just barely trailed the technological schools in introduction of new degree programs and introduction of courses and instruction leading to careers in data processing and computing. The liberal arts colleges ranked first in the introduction of freshman courses emphasizing structure, logic, set theory, etc. (53 percent), and teachers colleges were first in new or revised programs for mathematics teaching (53 percent).

Comparisons by Control

Public institutions introduced the innovations listed on the questionnaire relatively more frequently than did the private institutions, with two exceptions: The introduction of freshman courses emphasizing basic concepts, and the introduction of programs of advanced standing--both of which the private institutions had a slight edge.

Comparisons by Region

The regional breakdown shows a spread of innovative tendencies. The West and Far West region led in new degree programs, course expansion, new or revised programs for the preparation of mathematics teachers, and data-processing and computer courses; these innovations were adopted, respectively, by 32 percent, 67 percent, 41 percent, and 26 percent of the participating schools there. Their lead over the region with the second highest percentage in each of these types of innovation generally was considerable. In three of these four types of innovation, the closest competitor was the North Atlantic region, which led, in its own right, in freshman course revision, mathematics courses for the biological and social scientists, and programs of advanced standing; these innovations were adopted, respectively, by 52 percent, 26 percent, and 32 percent of the participating schools there. Second to the North Atlantic region in these types of innovation was the Great Lakes and Plains region. Least innovative of all was the Southeast region.

Comparisons by Enrollment Size

With only two minor exceptions, there was a direct correlation between size of institution and the tendency to adopt innovations. These exceptions were the slightly higher percentages among institutions with enrollments between 1,500 and 5,000 than among those with enrollments of more than 5,000 in new degree programs and in new or revised programs for the preparation of teachers. Institutions with enrollments of fewer than 700 tended generally to make relatively few of the innovations listed on the questionnaire.

Frequency of Innovations per Institution

The kinds of institutions that adopted a number of these new programs may be a more meaningful index of innovational tendencies. Fifty-three percent of the universities that instituted any of these reforms had instituted four or more during the past decade. Comparable figures for other types of institution are 30 percent for liberal arts schools, 41 percent for teachers colleges, and 40 percent for technological institutions. Similarly, whereas only 30 percent of the private institutions in the survey had made four or more innovations, 49 percent of the public institutions had done so.

Using this scale, few regional differences appeared. In the North Atlantic region, 37 percent of the innovating institutions had adopted four or more reforms; for each of the other three regions--the Great Lakes and Plains, the Southeast, and the West and Far West--the corresponding figure was 35 percent.

COMMENTS AND OBSERVATIONS ON UNDERGRADUATE PROGRAMS (ITEMS 17 AND 18)

Number of Comments

The questionnaire's invitations to comment elicited some sort of response from 420 of the 877 participating institutions, or 48 percent. In considering these responses, the reader should realize that, unlike the rest of the questionnarie, these items were expressly intended to elicit subjective data.

Most pronounced of the problems cited were that of the mathematics department's being made a service department for other departments of the college, and that of upgrading or modernizing the mathematics curriculum. Of the 420 respondents, 99, or 24 percent, mentioned the former, and 103, or 25 percent, the latter.

The Mathematics Department as a Service Department

Service requirements involved many activities. Various schools recognized the necessity of supplying adequate mathematics courses for the physicists and chemists, statistics and probability theory for the social scientists, and at those schools which had a general education requirement, a course that was simultaneously an adequate introductory and an adequate terminal course in mathematics. The most pronounced awareness of the problem of service courses seemed to exist in the teachers colleges, where the major academic task is to train teachers of secondary and elementary education. The problem, however, appeared to be a universal one: All sizes and types of school, both public and private, all over the country, indicated their concern, as shown in some of the following comments:

A private liberal arts college, Great Lakes and Plains region, enrollment between 700 and 1,499: "Next year there will be approximately thirteen courses servicing other departments in the school and about nine courses for mathematics majors and minors. Some of the advanced courses are still alternated during two years to permit a greater variety."

A private technological college, North Atlantic region, enrollment between 1,500 and 5,000: "The Department of Mathematics... is a part of the School of Engineering. Courses of instruction in mathematics are offered for students in the various engineering curricula, architecture majors, chemistry majors, and mathematics majors."

An institution, similar to the preceding one, except that its enrollment is more than 5,000: "Undergraduate work in this department is tailored to the needs of engineering students in electricity, chemistry, and mechanics."

A small private liberal arts school in the Midwest: "A serious remaining problem concerns intermediate algebra. Students in areas not requiring the calculus, but requiring such courses as elementary physics, chemistry, statistics, and mathematics of finance, have elected to take intermediate algebra even when they have credit for two years of high school algebra."

A small, private, liberal arts college in the East, enrollment below 700: "The one question we have still not resolved is whether the mathematics major for those going into secondary teaching should be any different than for those planning to continue graduate work in mathematics with other goals in mind."

A small private liberal arts college in the West: "The major innovation at present is the beginning of a mathematics program for elementary school teachers."

A private liberal arts institution in the East: "There is no program specifically designed for the preparation of mathematics teachers. There is a pseudo program to produce physics-mathematics teachers."

A small private Southeastern liberal arts school that provides inservice training facilities for secondary school teachers: "During the fall of 1958 some of the high school teachers of mathematics held several meetings [here] to discuss some of the concepts such as logic, set theory, etc. In the spring and summer of 1959 some of these teachers attended our mathematics seminar, for our juniors and seniors, in which we studied recommended curricular revisions of the mathematics program for high schools and CUPM recommendations for beginning college courses."

A State university in the West, enrollment between 1,500 and 5,000: "The major unsolved problem of the undergraduate mathematics program is not how to present mathematics to the students who are to become mathematics teachers and/or mathematicians, but rather how to do this and provide the training which is essential to the other sciences and engineering."

Among the solutions most often suggested were special courses for the non-major to provide him with the mathematics requisite for his task. A less frequently mentioned alternative was to establish special programs, or tracks, for the non-major and the major.

Updating in the Mathematics Curriculum

Updating the mathematics curriculum came in for much attention, for several reasons apparently. One was that entering students at many institutions seemed better able to handle advanced mathematics, and another, the need to introduce changes that would prepare students better for present-day mathematics requirements. Here are some sample comments:

A small Eastern private liberal arts college: "The content of all our courses has been modernized. Such traditional courses as college geometry and theory of equations have been dropped, and courses in projective geometry, number theory and modern algebra have been added."

A small private technological school in the East: "In general, what were first-year graduate programs in 1950 have been made senior-year courses in 1960."

A small private liberal arts school in the East: "Our program provides for a junior and senior seminar. This permits the mathematics department to keep up with the modern trends in mathematics."

A large private Eastern university: "Modern mathematics emphasized in all courses is the objective toward which we are working. With a knowledge of the concepts and foundations, students will be better equipped to think in the field instead of performing operations mechanically. The 'How' and 'Why' should go hand in hand."

In different parts of the country modernization meant different things. Although another question in this survey dealt objectively with the courses these schools now teach, and those which they had introduced during the past 10 years, it is interesting to note what various respondents considered as modernization.

A small private liberal arts school in the West: "The most serious deficiency in the undergraduate mathematics program at the present time is that there is no course in the foundations of mathematics."

A moderately large, public liberal arts institution in the West: "We still need courses in geometry, numerical analysis, modern computation, and history of mathematics to round out our bachelor's degree curriculum."

A small public technological institution in the Southwest: "[We] now require for a mathematics major both advanced calculus and differential equations as well as recommending vector analysis. Courses in college algebra and geometry have been updated to include contemporary algebra and geometry."

A moderately large, private liberal arts college in the Great Lakes region: "Three years ago the requirements for a major in mathematics were increased from 14 hours beyond calculus to 26 hours beyond calculus. We found that giving matrices and modern algebra to juniors increased their interest in mathematics and also prepared them to profit from point set topology in the fourth year."

As mentioned above, it was the improvement in the secondary schools that had facilitated this upgrading. In part, these changes permitted the dropping of a trigonometry-algebra course as the introductory course for freshmen, and its replacement by an analytic geometry-calculus course. Another common response was the integration of trigonometry and algebra and also of analytic geometry and calculus. There were some indications that "depressed areas" existed, in which improvement in secondary education had been minimal or nonexistent, but the improvement did seem to be nationwide. Responses to such improvement and the upgrading that it made possible included placement examinations with tracks for freshman year, advanced-placement credit, and honors programs.

The Quality of Entering Freshmen

Unlike awareness of the mathematics department's functioning mainly as a service department and of the necessity of upgrading courses to meet professional standards, the impression of an improving quality of entering freshmen was not uniformly distributed over institutions of all types, sizes, regions, and kinds of control. Of the 420 institutions that responded to the invitation to comment, 55 mentioned problems caused by improved high school preparation. Of the 288 private institutions which offered comments, 43, or 15 percent, were so concerned, compared to 12, or 9 percent, of 132 public institutions. Although these percentages are hardly conclusive, they do suggest that relatively more of the better-prepared students were entering private institutions.

Similarly, there were suggestive regional differences on the improving quality of entering freshmen. Sixteen percent of those institutions in the Great Lakes and Plains region that offered comments expressed an awareness of this problem, compared to 16 percent in the North Atlantic region, 12 percent in the Southeast region, and only 3 percent in the West and Southwest region. These figures indicate a fairly high consciousness of change in the Great Lakes and Plains, in contrast to an almost non-existent one in the West and Southwest. Here are some of the comments on the improving quality of entering freshmen:

A small private liberal arts college in the East: "By advanced standing we have meant calculus. However, in 1961 we will offer calculus with analytic geometry as a freshman course for students with adequate high school preparation."

A small Eastern private liberal arts college: "Incoming students have 3 or 4 years of high school mathematics, some of which is of college level."

A small private technological school in the East: "The incoming freshman seems better prepared."

A small private liberal arts school in the East: "We used to offer college algebra and trigometry to freshmen and did not start calculus and analytics until sophomore year (except for students given advanced standings). We now start calculus and analytic geometry in the freshman year and as a result we have added advanced calculus to the program."

A small Midwestern private liberal arts college: "I am hoping that the freshman program may be expanded more to allow well prepared students to start in taking analytic geometry and calculus courses.

"Better entrance tests and placement of students from advanced placement tests given in high school more adequately and efficiently are desirable objectives hoped for in the near future."

A small private liberal arts school in the Southwest: "We are planning to make trigonometry and college algegra non-credit courses. We are creating a separate course in analytic geometry so that suitable entering freshmen may go directly into the calculus. Analytic geometry and calculus will not be given as an integrated subject."

A small liberal arts college in the Southwest: "This year, for the first time, some entering freshmen were placed in analytic geometry. This was done on the basis of high school records and scores on the entrance examinations. No special placement examination was given."

A moderately large, private liberal arts college in the West: "A problem facing us at present is to know what is the best content for the freshman year of college mathematics. Most students who have had four years of high school mathematics seem unprepared to start a rigorous course in calculus in their freshman year. Many students come to college with a superficial knowledge of much of the mathematics taken in high school. They know a little algebra, a little trigonometry, some modern concepts, some analytic geometry and have a thorough knowledge of none of these. They are weak in necessary algebraic techniques."

A moderately large State university in the Southeast: "A large percentage of entering freshmen have had only one unit of high school mathematics; even those who wish to major in mathematics have had (only) algebra and, perhaps, geometry and trigonometry."

Even within States, improvement in high school training in mathematics was not uniform. For some schools the variation in background of the incoming freshmen presents some of their most pressing problems. This problem appeared most frequently among the small, private liberal arts colleges. Following are some comments on this topic:

A small private liberal arts college in the West: "Entering freshmen are coming with more and more varied high school preparation; a small college finds it difficult to provide a curriculum which will meet their needs."

A small private liberal arts college in the Great Lakes area: "Mathematics is an elective at (our) college. Freshmen who elect mathematics are divided into two groups: those who have had only two years of mathematics and those who have had three or four years in high school. The first group takes college algebra and trigonometry. It is the second group which presents a problem. For the past four years I have given a four-hour course in analytic geometry to this group. Last year 13 students came from 13 different high schools outside the city while five were from the city. Hence their preparation was so varied that it presented a great problem. I am not satisfied with the present program and am contemplating a change."

A small private liberal arts school in the Great Lakes area: "Unsolved problem--articulation of our first two years with high school mathematics. A small school with only two mathematics teachers finds it difficult to provide just the right course for all the widely different degrees of preparation we encounter."

A moderately large, State teachers college in the North Atlantic region: "As we attract more of the better students, we will have to provide for more extreme variations in backgrounds and abilities. We expect to do this through the initiation, September 1, 1961, of Honors and Advanced Standing Program."

Providing Suitable Mathematics Courses for General Education

The offering of suitable mathematics courses for students who take mathematics to meet a general education requirement appeared to be a problem at a number of institutions. Below are some of the comments on this topic:

A small private liberal arts school in the West: "The most serious deficiency in the undergraduate mathematics program at the present time is that there is no course in the foundations of mathematics. This is partly due to the fact that there are no mathematics courses included in the general education requirements. The department feels that at least one year of appropriate mathematics courses should be required of all candidates for the B.A. degree."

A small private liberal arts school in the East: "Would like to require a college-level course of all liberal arts students--at present their curriculum is already too full."

A small public liberal arts school in the Southeast: "All students are now required to complete the equivalent of 6 semester hours of mathematical analysis before graduation. This will eventually be largely a freshman course, but it is now taken by students from all four classes."

A small private liberal arts school in the Southeast: "Problems: a) should some mathematics be required of all students? b) should there be only one or several different courses designed to fulfill this requirement? and c) of what nature should such required courses be?"

A small private liberal arts college in the East: "All entering freshmen take CEEB, SCAT, STEP test. The ratings on these tests in mathematical ability, together with a knowledge of the student's record in high school mathematics and grades in Regents examinations, serve as a guide to separate students into homogeneous groupings. The two groups with the highest scores start mathematics in the freshman year. Other students with lower grades and no indication of further interest in mathematics or science wait until the sophomore year to begin mathematics. The first year of college helps them to adjust to the collegiate curriculum and methods. They seem a bit more mature in the sophomore year."

The Mathematics Faculty

There were several matters brought up in this section which were of only peripheral relevance to problems of curriculum. One of the more striking was the concern of the respondents that their faculties were inadequate to the various tasks now being imposed on mathematics departments. Although most of the complaints were about size of staff, several were about faculty hostility to the "new" or "modern" mathematics, and a few were about faculty overeagerness to abandon the "old" or "solid" mathematics. This problem (mentioned by 45, or 11 percent of the 420 institutions) was felt most strongly by colleges in the 700 to 1,499 enrollment range. Whereas schools of this category make up only 137, or 33 percent of the 420 respondents to this item, their concern with this particular problem is indicated by 20 of 45, or 44 percent, of these responses. Some of the comments were as follows:

A large private university in the middle West: "Because of the tremendous shortage of mathematically trained people it will be necessary for many years to use graduate student assistants in the teaching of undergraduate courses. We feel that if we could work with our incoming graduate students during the summer preceding their entrance into our graduate school, we could significantly improve their performance as teachers. We would like to have the funds for such a program."

A small private liberal arts college in the East: "We do not offer many mathematics courses in our college. We could not teach some of them, because we do not have enough mathematics teachers. The teaching load for mathematics teachers is heavy and their salaries are low."

A small private liberal arts college in the West: "We try to make good use of the visiting lecture programs available. Our very small staff is a real handicap both to students and to the staff!"

A small, State teachers college in the West: "Our mathematics offerings were carried on a 'one-man' basis until 1958. We are now offering two advanced courses each quarter where we had previously offered only one."

A small, State teachers college in the Great Plains area: "These plans [for expanding and updating the mathematics programs] depend on two things . . . obtaining and keeping an adequately prepared staff. (This is the greatest problem)."

A small private liberal arts college in the Great Plains area: "We get hurt by non-availability of competent staff. We released (in June 60) two master's degree teachers and replaced them with two outstanding graduating (B.S.) students. I now handle all advanced courses (except one) in physics and mathematics and try to help my new instructors."

A small private liberal arts school in the Southeast: "Our college is a small college for women. Its mathematics department is small both student-wise and staff-wise. The burden of instruction falls on me. My preparation has been strictly theoretical and hence the course offerings lean away from applied mathematics."

This situation has been aggravated by a trend, revealed in the responses, toward the formation of new departments and majors and also of new schools. Forty-five institutions referred to the creation of either a major in mathematics for the first time, or the formation of a mathematics department. Twelve institutions stated that they had come into existence within the 10 years covered by the question. Moderately large schools (enrollments of 1,500 to 5,000) show a disproportionately large increase in the number of new departments and majors, with 42 percent of the increase being due to such schools though they represent only 27 percent of the total number of institutions.

Also adding to the need for more staff was the tendency to increase the course load required of undergraduate mathematics majors. Twenty-six institutions indicated that during the past 10 years they had raised the number of credit-hours required of mathematics majors.

Appearing in the comments and observations were also expansions on questions already dealt with in the main body of the questionnaire. Many schools discussed their placement examinations, honors programs, and particular courses. Since these topics are treated elsewhere in this book, the comments will not be amplified on here.

CHAPTER III. GRADUATE PROGRAMS
(Part II of the Questionnaire)

As explained in Chapter I, data were obtained from more than 95 percent of the universe of programs at the master's level and from 100 percent at the doctoral level. The lists of institutions having these programs, and specific characteristics of the programs as reported by the institutions, appear in Appendixes A and B. Appendix A lists the 36 institutions that were known to confer master's degrees in statistics. This list was compiled chiefly from the 1956-57, 1957-58, and 1958-59 reports on Earned Degrees Conferred of the U.S. Office of Education. Too few institutions provided detailed data about master's programs in statistics to make possible any reliable statistical analysis of them.

Two institutions--DePaul University in Chicago and Kansas State Teachers College at Emporia--reported that, in addition to a master's degree, they award a specialist's degree, which is intermediate between a master's and a doctor's degree. At DePaul the degree is Degree of Mathematics Specialist; the requirement for it is 48 semester-hours beyond the bachelor's degree. At Kansas State Teachers College, the degree is Specialist in Education, and the general requirements for it, beyond those for the master's degree, are 9 semester-hours of professional education, 15 semester-hours in courses open only to graduate students, and a field study (thesis) of not more than 6 semester-hours.

MASTER'S PROGRAMS IN MATHEMATICS (SECTION A)

Data were obtained on 220 master's programs in mathematics. (See Appendix A for the list of institutions having these programs and specific data on them.) With only a few exceptions (for example, the separate master's programs in the College of Letters, Science, and Arts and in the Institute of Technology at the University of Minnesota), these programs represent different institutions or distinct campuses of institutions, such as the University of California campuses. In the discussion which follows, these separate campuses, as well as departments that have distinct mathematics programs of their own, will be considered as "institutions."

Kinds of Degrees Awarded

Of 214 institutions which gave the names of the specific master's degrees that they award in mathematics, 64, or 30 percent, conferred the Master of Science (M.S.) degree alone. Two of these 64 titled the degree S.M., probably to duplicate the word order on a diploma in Latin. A Master of Science in Applied Mathematics was awarded by four, or 2 percent, of the institutions. Eighty-seven, or 41 percent, granted the Master of Arts (M.A.) degree alone, with two of these calling it A.M. In addition, one institution gave a Master of Arts in Natural Science and another, a Master of Natural Science. Fifty-nine, or 28 percent, of the institutions conferred both the M.A. and M.S., and set slightly different requirements for each.

In summary, a student might, upon completion of a master's degree program in mathematics, receive an M.S. at 123, or approximately 57 percent, of the reporting institutions; an M.A. at 146, or approximately 68 percent; a Master of Science in Applied Mathematics at 4 institutions; a Master of Arts in Natural Science at 1 institution; or a Master of Natural Science at 1 institution.

Credit Requirements in Mathematics

Two hundred seven institutions reported their requirements in terms of credit-hours in mathematics. The number of required semester-hours ranged from 12 to 36, both the median and the mode being 24 semester-hours. Because of variations allowed within a program, some institutions represented required credit-hours in mathematics in terms of a range. The ranges in semester-hours extended from 15-20 to 30-36.

The number of required quarter-hours in mathematics ranged from 18 to 46, the median being 33 and the mode 30.

Total Credit Requirements for the Degree

Two hundred four institutions reported a specific number or range of credit-hours required. The total number of required credits in semester-hours ranged from 18 to 38, the median and the mode being 30 semester-hours. Again, some requirements were expressed as ranges, extending from 18-24 to 30-38 semester-hours.

The total number of required credits in quarter-hours ranged from 30 to 48, with the median and mode 45 quarter-hours.

In 58 institutions the credit-hour requirement was all in mathematics. In the remaining institutions it was divided between a certain number of credit-hours required in mathematics and a certain number that could be earned either in mathematics or in other subjects.

Thesis Requirements

Of the 220 institutions reporting master's programs in mathematics, 114, or 52 percent, required a thesis. Of these 114, some required a thesis for one degree only where more than one degree was offered; some permitted an alternative of two papers, and one permitted the alternative of an expository paper and nine extra credit-hours. At 77, or 35 percent, of the institutions the thesis was optional. Twenty-eight, or 13 percent, of the institutions made no provision at all for a thesis.

Foreign Language Requirements

A modern foreign language was a requirement of 97, or 45 percent, of the 218 institutions responding to this question. Of the 97 institutions, 15 required a foreign language only for a specified degree, for a particular plan within a program, or in one department of the institution. Two institutions required knowledge of two modern languages: French and German at one, and any two from among French, German, or Russian at the other. At one institution a test in basic statistics could be substituted for a foreign language.

Special Methods of Obtaining Degrees

It was possible to earn the master's degree in mathematics by evening and/or Saturday study at 59, or 27 percent, of the 220 reporting institutions and through summer study alone at 82, or 37 percent.

Final Comprehensive Examination Requirements

Of 217 institutions responding to this item, 192, or 88 percent, required some kind of final comprehensive examination; 1 left such an examination optional; and 24, or 11 percent, had no provisions for it.

Of the 192 institutions requiring a final comprehensive examination, 114, or 59 percent, required only an oral examination--to be taken at one institution before the student started his thesis work. Twenty-four, or 13 percent, of the institutions required a written examination, which in one case might be supplemented by an oral examination if deemed necessary.

A combination of both an oral and written examination was part of 52, or 27 percent, of the programs. At one institution both examinations were required only when a student's grade point average was under 1.5. At one institution an oral examination was required for M. A. candidates and a written one for M. S. candidates. At another institution an oral examination was part of the thesis plan and a written one, part of a non-thesis option. In three other programs either an oral or a written examination was required. One department head said that the choice was made by the staff according to the number of candidates: if the number was large enough to make an adequate reading of written examinations impossible, then an oral examination was substituted.

"Minor" Requirements

Fifty-five schools, or 25 percent of the 216 which responded to this item, reported that a minor was required; 76, or 35 percent, that a minor was optional, with one program limiting the minor to physics only; and 95, or 44 percent, that no provision was made for a minor.[1] In the last group, one respondent said that no provision for a minor was made for M.S. candidates, implying that for candidates of another degree, some provison might be made.

Provisions for a Minor in Mathematics

At 144 institutions, or 68 percent of the 213 respondents to this item, a mathematics minor, acceptable in conjunction with a master's program in another department, was available. In one school a mathematics minor was acceptable only for majors in chemistry and life science. In 33 schools where mathematics minors were acceptable in conjunction with a master's program in another department, the mathematics department itself made no comparable provision for its own degree candidates.

Variations in Programs

Of the 220 institutions reporting master's programs with a major in mathematics, 45 responded that they had several master's programs with slightly varying requirements. Actually this figure is rather high because of different interpretations of the question. Whereas the respondents were asked to point out the differences among their several master's programs in mathematics some respondents pointed out unique features of their programs as compared with typical master's programs in mathematics and some elaborated on a particular program.

Among those interpreting the item in the latter sense, one institution pointed out that although it granted the master's degree, it did not intend to admit students seeking a terminal master's degree. Two other institutions reported that their master's programs were basically 2-year programs, with the total number of hours not of primary consideration. One institution said that its requirements were not stated in terms of a specific number of credit hours, but rather in terms of a certain amount of knowledge, as shown by an examination; usually students acquired this knowledge by taking courses but were not required to do so. Still another institution claimed that its master's program was definitely tailored to meet the needs and future career plans of the individual student.

In elaborating on their particular programs, some department heads reported basic core requirements. In some instances specific courses were required: one institution required one year of complex variables, one year of algebra, and one year of geometry--some or all of which might be taken before the bachelor's degree; another called for six semester-hours each in modern algebra, probability and statistics, and introductory real variables. In other cases, candidates had to take a certain number of advanced, completely graduate courses; for example, in one program a student was required to take two strictly graduate courses, whereas the rest could be senior college courses.

Some institutions did report actual differences among their master's programs in mathematics. A common cause for a diversity of programs was the granting of both Master of Arts and Master of Science degrees. In one institution candidates for the M.A. were permitted to take courses in other graduate fields, while candidates for the M.S. were required to take more graduate units in mathematics and had more specific courses prescribed. In one institution a minor was optional for the M.A.; in another a thesis, worth 5 to 9 quarter-hours, was required for the M.A., and a special research paper worth 3 quarter-hours, for the M.S. The course work and thesis for the M.S. in one institution emphasized application to industry, whereas the M.A. degree program stressed pure mathematics. At another institution, where candidates for an M.A. had to write an expository thesis, M.S. candidates either had to write a research thesis or else pass the general examination for the Ph.D.

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[1] Percents do not add to 100 percent since some institutions may have various requirements within the same program.

In some institutions specialized degrees other than the M.A. or M.S. were granted as either the regular degree in mathematics or as alternative degrees. At one institution, students completing a master's program with mathematics as the major field of interest were granted the degree Master of Science in Engineering Science, and in two other institutions, the Master of Arts in Natural Science. An alternative degree, Master in Letters, was offered in one program, with requirements of 16 to 20 credits in mathematics and 10 to 14 in related fields and with no thesis. Some institutions also offered specialized degrees in applied mathematics and in statistics.

Frequently, there were variations at one institution in thesis requirements for master's degrees. A common pattern was to offer two alternative plans, one with a thesis and one without. In programs requiring a thesis, there were usually a foreign language requirement and a smaller required number of credit-hours than in non-thesis programs. To compensate for the waiving of a thesis requirement, non-thesis programs usually called for more credit-hours in the major field and also in the minor, where one existed, and sometimes additional papers. For example, Plan A in one program called for a thesis, 18 credits in the major, and 9 credits in the minor; Plan B required 27 credits in the major field, 18 credits in a combination of two minors, and three papers. At some institutions, highly individualized arrangements or substitutions were occasionally made, such as allowing a student to write a thesis in an applied area outside mathematics or to substitute a final comprehensive examination for a thesis.

Other variations occurred in major/minor combinations and in related study areas. One institution allowed four different alternatives:

(1) A major of not less than 30 semester-hours;
(2) A major of not less than 20 hours, plus a minor of 10 hours;
(3) A major of not less than 20 semester-hours, plus 10 hours of related courses; or
(4) A split major arranged by the adviser and approved by the Graduate Dean.

At some institutions students could choose to do as much as half their course work in physics; one institution permitted students to take 6 hours of work in areas with no immediate connection with mathematics. At another institution candidates could take all 30 hours in one department or a maximum of 12 in a "related area."

Finally, program variations also existed at institutions where no program was specifically designed for preparing teachers, but where special provision was made for teachers who wished to enroll in regular master's degree programs in mathematics. In one program, high school teachers could combine mathematics and physics. In another they could write a thesis on some phase of mathematics related to their teaching positions.

MASTER'S PROGRAMS SPECIALLY DESIGNED FOR THE TEACHING OF MATHEMATICS (SECTION B)

Data were obtained from 183 institutions on master's programs specially designed to prepare mathematics teachers. (See Appendix A for the list of institutions with these programs and specific data on them.) These programs are primarily directed at upgrading the qualifications of secondary school teachers of mathematics. Many of them have been newly established as a result of the emphasis in recent years on improved teacher preparation, stemming in turn from the introduction of newer mathematical concepts into many curriculums. The National Science Foundation institutes, have lent great impetus to these trends. Even a new degree, Master of Arts in Teaching, was finding favor among an increasing number of institutions.

Kinds of Degrees Awarded

Of 181 institutions which gave the names of the specific master's degrees awarded for mathematics-teaching programs, 81, or 45 percent, conferred a Master of Arts degree in some form (see below); 73, or 40 percent, a Master of Science degree; and 48, or 27 percent, an Education degree. One institution gave a Master of Mathematics degree. Some institutions provided for variations within a given program and as a result offered more than one type of degree for the same program.

Of the 81 institutions awarding a Master of Arts degree, 39 conferred a straight M.A.; 28, a Master of Arts in Teaching (M.A.T. or A.M.T.); and 9, a Master of Arts in Education. The remaining institution in the group granted more specialized degrees, such as a Master of Arts for Science Teachers, a Master of Arts in Secondary Education, a Master of Arts in Natural Science; and a Master of Arts in Teaching in Science and Mathematics.

Of the 73 institutions bestowing a Master of Science degree, 29 gave an M.S.; 23, a Master of Science in Education; and 10, a Master of Science in Teaching (M.S.T.). Other institutions granted such degrees as Master of Science in Basic Science, Master of Science in General Science, Master of Science in Natural Science, and Master of Science in Mathematics Education.

The most common Education degree was the Master of Education (M.Ed.), conferred by 38 institutions. Four awarded a Master of Teaching; and the rest, such degrees as Master of Teaching Science (M.T.S.), Master of Education in Natural Science, and Master of Secondary School Science.

Credit Requirements in Mathematics

One hundred seventy-six institutions reported their mathematics requirements in terms of credit-hours. The required number of semester-hours ranged from 6 to 36, both the median and the mode being 18 semester-hours. Since some institutions allowed for variations in a student's program, credit-hours were sometimes presented as a range. The ranges in semester-hours ran from 6-9 to 24-30 semester-hours.

The total number of credits required in quarter-hours ranged from 6 to 45, with a median of 27 quarter-hours and equal modes of 18 and 30 quarter-hours. Quarter-hours expressed in ranges extended from 9-27 to 33-36.

One institution reported that there were no credit requirements in mathematics in its program.

Credit Requirements in Education Courses

Specific credit requirements in education courses were reported by 153 institutions. In those institutions on the semester plan, the required semester-hours ranged from 2 to 26, with the median being 10 semester-hours and the mode 6 semester-hours. Those requirements expressed as ranges ran from 0-6 to 18-24.

Quarter-hour requirements in education courses ranged from 3 to 36, with the median being 15 and the mode 12. The ranges in quarter hours extended from 8-16 to 24-30.

Twenty-six institutions reported that they had no specific credit requirements for education courses.

Total Credit Requirements for the Degree

The total credit requirements for the master's degree were reported by 175 institutions. The range in semester-hours was 24 to 36, the median and mode both being 30. Again, some requirements were expressed as ranges; these extended from 30-35 to 30-38 semester-hours.

The range of total quarter-hour requirements was 36 to 60, with the median and mode both being 45. Two institutions recorded the requirements in terms of ranges, 39-54 and 45-60.

Thesis Requirements

Of the 183 institutions reporting master's programs expressly designed for the teaching of mathematics, 38, or 21 percent, required a thesis; some of these required it for one degree only where more than one degree was offered, and others allowed the alternatives of an expository paper, two papers, or an essay. Seventy-four, or 40 percent, of the institutions made the thesis requirement optional, in two instances for one degree only. Seventy, or 38 percent, of the institutions made no provision at all for a thesis.

Foreign Language Requirements

A modern foreign language was a requirement in only 17, or 9 percent of the 182 institutions responding to this item. In 3 of these 17, the language requirement applied only to candidates for the M.A. degree; and at 2 other institutions of the 17, a test of basic statistics could be substituted for the language requirement.

Special Methods of Obtaining Degrees

It was possible to earn the master's degree by evening and/or Saturday study in 55, or 30 percent of the 183 reporting institutions, and through summer study alone in 135, or 74 percent of them. At one of the latter institutions, only the M.Ed. could be obtained by summer study, not the M.S.T. degree. That almost three-fourths of the colleges and universities made it possible to earn a degree through summer study alone is evidence of the special effort to accommodate teachers.

Final Comprehensive Examination Requirements

Of the 183 institutions reporting mathematics-teaching programs on the master's level, 180 responded to the item on final comprehensive examination. Of these respondents, 135, or 75 percent, required some kind of final comprehensive examination; 44, or 24 percent, had no provision for such an examination; and 1 reported that no decision had yet been made.

Of the 135 institutions requiring a final comprehensive, 51, or 38 percent, required only an oral examination (although at 1 institution, a written report on independent study had to be submitted as well). Thirty-nine, or 29 percent, required a written examination (to be supplemented, at 1 institution, by an oral examination if deemed necessary, and required, at another school, for non-thesis students only).

A combination of both an oral and written examination was a part of 42, or 31 percent, of all programs reported. In three other programs either an oral or a written examination was required.

"Minor" Requirements

A minor was required in 40, or 24 percent, of the 167 institutions responding to this item. At one institution the minor was a requirement for the "credential" which must accompany the degree in this type of program rather than for the degree itself; at another institution minors had to be taken in two of the following fields: astronomy, physics, biology, geology, and chemistry. A minor was optional at 45, or 27 percent, of the institutions, with the condition at one institution that an undergraduate requirement of 32 hours of science be made up if not already completed. At 82, or 49 percent, of the responding institutions, a minor was not required.

Provisions for a Minor in Mathematics

Of the 166 institutions reporting on this item, 105, or 63 percent, said that a minor, acceptable in conjunction with a degree program in another department, was available; one specified that such a minor was acceptable only in conjunction with the physical sciences. Sixty-one, or 37 percent, reported having no such provision.

Variations in Programs

Of the 183 institutions and branches of institutions with mathematics-teaching programs at the master's level, 46, or 25 percent, provided pertinent and interesting information on variations among their programs. As in regular master's programs in mathematics, there were different interpretations of the questionnaire item.

Some institutions that offer more than one special degree-program for those who plan to teach mathematics used this item to describe how other, similar programs of theirs varied from the one described in Items 1-5. An examination of these responses led to the following generalizations. Programs leading to an M.A. or M.S. degree frequently required a large proportion of credit-hours in mathematics and, more often than in other degree programs, had a thesis and foreign language requirement. Master of Education degree candidates, in contrast, were usually required to earn only half or even fewer of their credit-hours in mathematics, with a thesis optional in many instances and with no foreign language requirement. One institution reported that candidates for the M.Ed. degree could take 12 hours of course work in extension courses. In programs leading to the Master of Arts in Teaching degree, the candidates usually took slightly more than half their course work in mathematics, frequently had to take specifically "graduate" education courses, and, more often than M.Ed. candidates, had to write a thesis and meet a foreign language requirement. (These generalizations were made only from responses in this section on variations and not from all data on all programs in this group).

Some institutions used this item to record variations allowed within one degree-program. Frequently a specific number of credit-hours in mathematics were required and a particular number of credit-hours specified for electives either in mathematics and/or related areas. For example, as a variation to one program where 20-24 semester hours in mathematics were required, a student could take as few as 10 hours in mathematics and 10 hours in a related field such as physics. In another program, rather than taking all 40 quarter-hours in mathematics, a student could take up to 15 quarter-hours in a related subject.

One institution reported a thesis option in the program. A minimum of 30-35 semester-hours, plus a research project, were required for the degree, but if a thesis were written, only 30 semester-hours were required and no research project.

In some programs the education course requirements varied greatly according to the student's undergraduate course of study. For example, one program required a student without any undergraduate credits in education to take 16 hours of education in graduate school; if a student had had the equivalent as an undergraduate, no education courses were required.

At some institutions, candidates could choose whether to major in mathematics and minor in education or vice versa. At one institution, when a student chose to major in education, he was required to take 18-24 semester-hours of professional education courses and 6-12 semester-hours in mathematics. With no practice teaching experience, he had to earn 6 additional credits in serving his apprenticeship. The same institution also offered an extended 12-month program for Retired Armed Services Officers, who had to take 21-27 semester hours in mathematics and 12-18 semester hours in education, including practice teaching, for a total of 39 semester-hours.

Another large group of respondents to the item on variations elaborated on specific, sometimes unique, characteristics of their programs. Some said that programs were available only to experienced teachers or to those who already possessed a Secondary School Teaching Certificate. One institution had a program designed especially for teachers in small high schools where mathematics and science were taught by the same person. Another had a program designed to prepare junior high school mathematics teachers only. At one institution a 6-hour course called "Elementary Mathematics from an Advanced Point of View" had been set up especially for high school teachers; and at another, a special course, "Elementary Mathematics from an Advanced Standpoint," which could be counted as either an education or a mathematics course, was offered. One program was a coordinated 5-year program leading to a B.A. in mathematics and an A.M.T. in teaching. As part of still another program, an expository paper in mathematics was required in cooperation with the College of Education, though not a part of the regular graduate degree requirement. Finally, one institution reported that although no formal professional education courses were required, special courses of interest to teachers were provided according to their previous backgrounds and preparation.

DOCTORAL PROGRAMS IN MATHEMATICS (SECTION C)

During the decade of the 1950's, 76 institutions (counting as separate institutions the University of California at Berkeley, the University of California at Los Angeles, the University of North Carolina at Chapel Hill, and the University of North Carolina, State College at Raleigh) awarded at least one doctoral degree each in mathematics. By 1961, 94 institutions were offering doctoral programs in mathematics, including applied mathematics and statistics, which are taught in separate departments at some universities. (See Appendix B for data on programs at each of these institutions.) Several of the respondents in this survey indicated that plans were underway to inaugurate doctoral programs at their institutions.

Kinds of Degrees Awarded

Of the 94 institutions awarding doctoral degrees in mathematics in 1961, 91 awarded the Doctor of Philosophy (Ph.D.) degree; 2, the Ph.D. in Applied Mathematics; and 1, the Ph.D. or the Doctor of Science, Sc.D.

Credit Requirements in Mathematics

The minimum credit requirements in mathematics at the 54 institutions which specified them varied considerably from institution to institution. For institutions on a semester-hour basis the minimum number of required semester-hours ranged from 36 to 96, with the mode being 60 semester-hours. Because of variations permitted within doctoral programs, four of these institutions reported the minimum semester-hour requirements in terms of ranges, extending from 45-60 to 74-90.

At the 10 responding institutions that were on the quarter plan, the minimum quarter-hour requirements in mathematics ranged from 45 to 145, with the median being 80. One institution expressed its minimum requirements as a range, 120-145 quarter-hours.

Total Credit Requirements for the Degree

The total number of credit-hours required for the doctor's degree was reported by 57 institutions, 47 of which were on the semester plan and 10, on the quarter plan. The remaining 37 institutions did not have a specified minimum number of credits. Of the 47 institutions on the semester plan, 26 included the credits earned for the thesis in the reported total credit requirements for the degree. At these institutions the total required number of semester-hours ranged from 36 to 96, the mode being 90 semester-hours. Twenty-one institutions on the semester plan reported total credit-hour requirements in courses only, a thesis also being required. These requirements ranged from 48 to 90 semester-hours plus a thesis, the mode being 60 semester-hours.

Of the 10 institutions on the quarter plan, 6 included credits earned for a thesis in the reported total credit-hour requirements, which ranged from 100 to 135 quarter-hours. At the four institutions not including thesis credits in total credit-hour requirements, the range extended from 67½ quarter-hours to 90 quarter-hours, plus a thesis.

In most of the institutions reporting specific credit requirements, the required credits were entirely in mathematics. Two institutions specified the number of required courses instead of the number of credits.

Several respondents emphasized that their figures represented absolute minimum requirements and that generally the totals for individual students were higher. Others said that, despite the specified requirements, the doctor's degree depended less on the accumulation of credits than on demonstration of qualifications considered requisite by the faculty and on writing a thesis involving original results. Some respondents stated simply that their minimum specified requirement was 3 years of study beyond the baccalaureate.

Examination Requirements

Ninety-two institutions made usable responses to this item. All but two required more than one type of examination. Seventy, or 76 percent of the 92 institutions, required an oral preliminary or qualifying examination; 58, or 63 percent, a written preliminary or qualifying examination; 41, or 45 percent, a final comprehensive oral examination; 20, or 22 percent, a final comprehensive written examination; 89, or 97 percent, an oral examination on the thesis; and 1, an examination on a minor thesis in mathematics.

Of the 90 institutions requiring more than one examination, 24, or 26 percent, required two. The most frequent combinations (at 14 institutions were an oral preliminary examination and an oral examination on the thesis, and (at 9 institutions) a written preliminary examination and an oral examination on the thesis.

Forty-five, or 49 percent, of the institutions required three examinations, the most common combination being an oral preliminary, a written preliminary, and an oral examination on the thesis.

Thirteen, or 14 percent, of the institutions required four examinations, the most common combination being an oral preliminary, a written preliminary, a final comprehensive oral, and an oral examination on the thesis.

Eight, or 9 percent, of the institutions required five examinations: an oral and a written preliminary, oral and written final comprehensive, and an oral examination on the thesis.

Foreign Language Requirements

Ninety-three schools required doctoral candidates to show competence in one or more foreign languages; the 94th responding institution failed to provide information on this item. Two languages were required in all programs with the exception of two programs at Harvard University (statistics and applied mathematics, which required only one language).

German, French, and Russian were the languages acceptable for the language requirement at 73, or 79 percent, of the institutions. Of this number, 10 specified German and French as the preferred languages; 5, German and Russian; 2, German; 1, French; and 1, French and Russian. Nine of the 73 institutions said that occasionally other languages vital for research in a particular field of interest might be substituted.

Thirteen, or 14 percent, of the responding institutions named Italian as a fourth, acceptable language; of these, specified German, French, and Russian as preferred languages; 4, German and French; and 2, German and Russian. One of the 13 institutions said that one language could be French or Italian, but that both would not be accepted. Another institution in this group required a strong reading knowledge in one language and a lesser proficiency in a second one.

At three institutions, German and French were the only acceptable languages. Two other institutions accepted German, French, Russian, and Japanese, with German, French, and Russian preferred at one and German and Russian at the other. One institution accepted German, French, Russian, Italian, and Japanese, with German preferred; and one accepted German, French, Russian, Italian, and Spanish, with German and French preferred.

In summary, all 93 institutions accepted German and French toward meeting the language requirements; 90, Russian; 13, Italian; 3, Japanese; and 1, Spanish. As indicated, some substitutions were permissible. In addition, 2 institutions indicated that the requirement for a second language was often waived for students whose native language was not English.

In specifying the level of foreign language competence required, 88, or 97 percent, of the institutions reported that reading comprehension only was required; 2, reading comprehension and the ability to write; and 1, the ability to speak and write.

"Minor" Requirements

Thirty-three institutions, or 35 percent, said that a minor was required; 29, or 31 percent, that a minor was optional; and 31, or 33 percent, that they had no provisions for a minor. One specified that the minor was usually in a second field of mathematics; and another, that the minor could be taken within the mathematics department.

Special Methods of Obtaining Degrees

At nine institutions a student could earn a Ph.D. in mathematics through evening and/or Saturday study, and at four, through summer study (see Appendix A for the names of these institutions).

Areas of Specialization and Numbers of Degrees

Many institutions which offered certain specializations did not award degrees in them between January 1958 and January 1961, the time period specified on the questionnaire. In many cases this was because the program was too new. For the statistical findings on this item, see table 23.

Table 23.--Number of institutions offering particular doctoral specializations in mathematics, and number of doctoral degrees awarded in each: January 1958 to January 1961, inclusive

Area of specialization	Number of institutions		Number of degrees awarded within this time interval
	Offering this specialization	Which gave one or more degrees within this time interval	
Algebra	76	46	110
Analysis	85	61	304
Applied mathematics	48	27	114
Geometry	39	17	28
Logic	24	11	18
Statistics	49	32	164
Topology	67	39	94
Number theory	9	5	9
Probability	3	3	4
Other	11	10	19

The 94 institutions with doctoral programs awarded a total of 864 doctor's degrees. Analysis was the most popular specialization, being offered at 85 of the institutions and accounting for 304 doctor's degrees, or more than a third of the total number. Algebra was next most popular from the standpoint of number of institutions (76) offering it for specialization, but it accounted for only 110 degrees, whereas statistics, offered by 49 institutions, claimed 164 degrees over the 3-year period. Applied mathematics (114 degrees) and topology (94 degrees) also accounted for sizable portions of the 864 degrees conferred.

DOCTORAL PROGRAMS SPECIALLY DESIGNED FOR THE TEACHING OF MATHEMATICS (SECTION D)

In 1961, 25 institutions offered a doctoral program specially designed for the teaching of mathematics. (See Appendix B for data on programs at each of these institutions.) Four of these programs had only recently been introduced.

The objectives of these programs varied. The objective at Yeshiva University was to prepare college teachers of mathematics. An expository or analytical thesis and 9 credits in education and psychology were the only essential differences from the traditional doctorate in mathematics. In most other programs the objective was to prepare an individual with dual competencies in mathematics and in professional education. Such degree holders frequently become mathematics teachers in junior or senior colleges, professors of mathematics education in universities, and specialists in mathematics education at local, State, and national levels.

Kinds of Degrees Awarded

The Doctor of Philosophy (Ph.D.) degree was the only degree offered at 8, or 32 percent, of the 25 institutions; the Doctor of Education (Ed.D.), the only degree in 6 others, or 24 percent; and either the Ph.D. or Ed.D. in the remaining 11, or 44 percent.

Credit Requirements in Mathematics

The credit-hour requirements in mathematics at the 13 reporting institutions that were on the semester plan ranged from 24 to 60 semester-hours, with the median being 34 and the mode 30. At two of these institutions, where both the Ph.D. and the Ed.D. were granted, credit-hour requirements differed for the two degrees. One institution required only 28 semester-hours in mathematics for the Ed.D. and 50 semester-hours in mathematics for the Ph.D.; similarly, the other required 30 semester-hours for the Ed.D. and 40 for the Ph.D. Because of variations permitted within the program, one institution reported its requirements as a range, 27-42 semester-hours.

The credit-hour requirements in mathematics for the three institutions on the quarter plan were 20, 36, and 72 quarter-hours. Eight institutions did not respond to this item.

Credit Requirements in Education Courses

Semester-hour requirements in education courses ranged from 9 to 48 semester-hours, with a median of 30. Again, credit-hour requirements in education courses differed for the Ed.D. and Ph.D. where both were offered by the same institution. One institution required 48 semester-hours in education courses for the Ed.D. and 36 for the Ph.D.; the other, 37 semester-hours for the Ed.D. and 12 for the Ph.D. Semester-hour requirements were expressed as a range at one school: 27-42 semester-hours.

Quarter-hour requirements in education courses were 16, 54, and 60 at the three institutions on the quarter plan. Eight institutions did not provide usable information.

Total Credit Requirements for the Degree

The total number of semester-hours required for the degree ranged from 60 to 96, with a mode of 90. Three institutions granting both the Ed.D. and Ph.D. reported a different total number of semester-hours required for each degree--at all three, the credit requirements were greater for the Ed.D. than for the Ph.D.

Two institutions on the quarter plan required a total of 108 quarter-hours for the degree; and one, 135 quarter-hours. Seven institutions did not report the specific number of credits required for the doctorate.

Examination Requirements

Of the 22 institutions reporting on this item, 15, or 68 percent, required an oral preliminary or qualifying examination; 16, or 73 percent, a written preliminary; 14, or 64 percent, a final comprehensive oral examination; 11, or 50 percent, a final comprehensive written examination; and 22, or 100 percent, an oral comprehensive on the thesis. One institution specified that the Graduate Record Examination and the Millers Analogy Test were required for admission to graduate study.

Three, or 14 percent, required 2 examinations; 6, or 27 percent, 3; 9, or 41 percent, 4; and 4, or 18 percent, 5 examinations. The most frequent combination at the nine institutions requiring four examinations was an oral and a written preliminary, a final oral comprehensive, and an oral comprehensive examination on the thesis.

Foreign Language Requirements

Respondents were asked if competence in one or more foreign languages was required in their doctoral programs. Two failed to provide the requested information. Of the 18 responding institutions that conferred the Ph.D. for this type of program, 16 required competence in two languages, and 2 required it in only one language. Of the 15 responding institutions that offered the Ed.D. degree, none required two languages, and only 2 required one language. One institution reported that knowledge of one or more foreign languages might be required if they were needed for a thesis.

When asked to name the languages accepted for meeting the language requirement, 10, or 59 percent, of the 17 institutions responding to this item checked German, French, and Russian, with 4 stating the substitutions that might be made upon petition. At two of these four institutions, a course on the use of computers or statistics might replace the foreign language requirement. At one, statistics might replace one language.

Two of the responding institutions named German, French, Russian, and Italian as acceptable languages, with German, French, and Russian being preferred at one of the institutions. Two additional institutions reported that German and French were the languages generally accepted, although the graduate council at one of the institutions sometimes accepted Russian as a substitute.

One institution accepted French, German, and a general knowledge of the Romance languages; two others accepted German, French, Russian, and Spanish, with the first three preferred.

In summary, all 17 responding institutions accepted German and French; 14, Russian; 4, Italian; 2, Spanish; and 1, Romance languages.

All 17 institutions also insisted upon reading comprehension as the necessary level of foreign language competency, with one institution specifying reading comprehension in the literature of mathematics.

"Minor" Requirements

At 12, or 50 percent, of the 20 institutions responding to this item, a minor was required for at least one of the doctoral degrees in mathematics-teaching programs; at 4, or 20 percent, a minor was optional; and at 4, or 20 percent, there were no provisions for a minor.

At two institutions where a minor was required, it was customarily in an area of mathematics other than the particular field of specialization. At another school, a minor in professional education was common, though not mandatory. One institution required two minors.

Special Methods of Obtaining Degrees

At only one institution could a student earn his doctoral degree through Saturday and/or evening study, and at only three, through summer study (see Appendix B for the names of these institutions).

Number of Degrees

Between January 1958 and January 1961 inclusive, 14 institutions awarded 63 doctorates specially designed for the teaching of mathematics. The largest numbers of these degrees awarded by single institutions were 18 and 15. Two institutions awarded 5. Another institution conferred 4 degrees; 2, 3 degrees each; 3, 2 degrees each; and 4, 1 degree each.

Special Programs for Preparing College Teachers of Mathematics

Although many mathematics-teaching programs at the doctor's level are intended for prospective secondary school teachers, at least two programs--one in operation at the time of the survey and one then in preparation--have as their special aim the training of college teachers.

The first of these two, at Yeshiva University, requires candidates to earn the same number of credits in graduate mathematics as are required in its regular Ph.D. program. The student is encouraged, however, not to specialize intensively, but rather, to select courses for breadth of coverage. A sequence of courses especially pertinent to college teaching, plus some experience in college teaching, are required. One significant variation from the traditional Ph.D. mathematics program is that the student may fulfill his dissertation requirement by submitting a serious study of some phase of mathematical thought without creating new mathematical theory or thought.

The Ph.D. mathematics-teaching program at Dartmouth College, established in 1962, also has as its principal aim the training of college teachers. This special program differs from the traditional Ph.D. program in requiring greater mathematical breadth. Teaching duties, which normally consist of conducting discussion sections in freshman courses for 4 or 5 hours each week, are part of the program.

To qualify for the Ph.D. in this program, the student must obtain a grade of Honors in at least five graduate courses at Dartmouth and in a general examination. In addition, he must pass eight advanced courses at Dartmouth, and show a capacity to read mathematical literature in two of the languages French, German, or Russian. He must also complete a thesis, which may either contain new mathematical theory or may be critical or expository in nature.

Additional Preparation for Teaching Mathematics in College (Section E)

Over the years a complaint frequently heard is that many professors are poor teachers even though they know their subject well. Another common charge is that faculty members entering the profession lack an understanding of basic principles of learning and of higher education in general. There is no unanimity on the need to correct these alleged inadequacies. Some colleges favor programs for this purpose; others seem indifferent; and still others oppose such programs as too general or as wasteful, since these inadequacies are overcome, they claim, after the first year or two of full-time teaching.

Nevertheless, an increasing number of institutions are providing programs designed to improve the preparation of college teachers. A total of 64 departments in 63 different institutions reported some arrangements for preparing college teachers. In all probability, there were many more programs than the responses indicated, since the heads of mathematics departments in larger universities might not be aware of all such programs in their institutions. Indeed, some heads made it clear that they could speak only for their own departments.

Statistical Findings

Of the colleges and universities offering these programs, about 70 percent were institutions with an enrollment of 5,000 or more, and approximately 75 percent of them were located in the Mideast, Great Lakes and Plains, and Southeast regions.

Of the departments responding on requirements for professional education for college teaching careers, 13 said that such courses or seminars were required; 21, that they were not required, but were encouraged; and 25, that they were neither required nor particularly encouraged.

Variations in Programs

There was wide variation in the kinds of preservice professional education available for college teachers in training. A few institutions had a separate Department of Higher Education. Other colleges offered a graduate minor in higher education. One State university, for example, offered a graduate minor in college teaching, which consisted of 15-24 quarter-hours of course work or seminars, including an independent teaching project under the direction of a faculty member in the student's major department.

Teachers for Junior Colleges

Several regular courses in the different phases of higher education were offered for future college mathematics teachers by the responding institutions, and in a few cases such courses were compulsory. With the rapid expansion in the number of junior colleges in this country, it was not surprising to see many courses devoted to that particular type of institution. One mideastern State university required those planning to teach in junior colleges to take "The Community College" and encouraged them to elect "Junior College Teaching." Other course offerings in this area included "Teaching in the Community College," "Junior and Technical Colleges," "Problems and Methods in Teaching on the Junior-College Level," and "Seminar in the Community College." Looking to the future, the department of education at one State college expected to add three courses, "The Public Junior College," "Junior College Curriculum," and "Internship in Junior College Education," to form the core of a new program for the preparation of junior college teachers.

Kinds of Courses and Programs

Frequently, courses of this type were required only for particular types of students and for specific degrees. One university required all graduate assistants to take the quarter-hour course, "Orientation to College Teaching," given in the Department of Higher Education; another required all new teaching fellows to attend each week a 1-hour seminar on preparing college teachers of mathematics, for which 2 semester-hours of credit were given. One Eastern university required all candidates for the Ph.D. in science- or mathematics-teaching to take the regular 3-hour course "The Philosophy of Higher Education," given at the school of education, and a seminar on teaching mathematics in college. In many instances, candidates for an M.Ed. or Ed.D. with a specialty in mathematics education were required to take specific courses in higher education.

Some heads of mathematics departments who did not know the exact titles of courses in higher education offered by other departments of the institution simply reported that such courses were given by the college of education, the psychology department, the school of vocational education and psychology, the department of general studies or, in one instance, by the dean of the graduate division.

A wide variety of specific courses was reported. One Southeastern university offered a two-semester course "History of Education in the United States" and a seminar "The Liberal Arts College and Its Philosophy." A Rocky Mountain university awarded one semester-hour of credit for each of two semesters for the course "Practicum in College or University Teaching;" this consisted of a series of lectures by individuals from all campus areas during the first semester and work with the major professor in the field of specialization during the second semester. Some of the other courses reported were "Origin and Development of Higher Education in the United States," "Comparative Higher Education," "Organization, Government, and Administration of American Higher Education," "International Organization in Higher Education," "Topics in Higher Education," "Methods of College Teaching," and "Internship in College and Junior College Teaching."

As indicated in the last-named course, provisions were made for student teaching in a few instances. Many of the graduate students were teaching-assistants as well and worked under the careful supervision of the department head, meeting with him and fellow graduate assistants for at least 1 hour a week to discuss problems and philosophy of teaching. One department head said that students presented, in their regular mathematics course, half-hour talks on specific topics in mathematics to gain practice in teaching ideas. One university offered courses preparing students to teach at the junior college level and at the 4-year college level, and two others reported having internship provisions.

Informal seminars or meetings, usually without credit, were commonly used to prepare college teachers. One mideastern State university had weekly lectures on college teaching, and attendance at these lectures was noted on students' transcripts. In other institutions it was the practice to have mathematics majors and graduate students meet occasionally to discuss teaching methods, curriculums, and job opportunities or to devote portions of subject-matter courses to these topics.

CHAPTER IV. SOME RELATED FACTORS
(Part I of the Questionnaire)

This chapter discusses factors that are not part of specific mathematics programs as such, but that are important to their overall success--clubs, mathematics contests, and visiting lecturers; instructional techniques that accommodate unusually large numbers of students; inservice education for mathematics teachers; libraries; and computing facilities.

ACTIVITIES DESIGNED TO STIMULATE INTEREST IN MATHEMATICS

Apart from formal courses, one of the most effective ways of promoting study and research in mathematics is the undergraduate club. Other ways include mathematics contests and visiting lecturers. Newsletters or bulletins prepared by the mathematics department and sent to high schools are an effective way of promoting interest in mathematics at that academic level and of attracting potential students.

The Undergraduate Mathematics Club (Item 12)

Almost half (49 percent) of the 877 institutions participating in this survey reported that they had an undergraduate mathematics club on campus. (See table 24.) Thirty-one percent of the 877 had local clubs with no affiliation; 7 percent had clubs affiliated with Pi Mu Epsilon; 6 percent, clubs affiliated with Kappa Mu Epsilon; and 5 percent had clubs with other affiliations.

Comparisons by category of institution.--Universities (73 percent) had clubs more than any other type of institution, and teachers colleges ranked second, with 51 percent. Pi Mu Epsilon clubs were popular at the universities, 32 percent of the universities having them. Kappa Mu Epsilon clubs were most common at the teachers colleges (10 percent).

Public institutions tended to have undergraduate clubs more than did private institutions (63 percent versus 41 percent). Public institutions also tended more to have affiliated clubs: 22 percent of them had clubs affiliated with Pi Mu Epsilon or Kappa Mu Epsilon, whereas only 9 percent of the private institutions had clubs so affiliated.

Regionally, there were no great differences, except that Kappa Mu Epsilon clubs were relatively popular (10 percent) in the Great Lakes and Plains region and relatively unpopular (2 percent) in the North Atlantic region, and that local clubs were especially popular in the North Atlantic region (37 percent).

There was a direct correspondence between enrollment size and undergraduate clubs on campus, which were found in frequencies ranging from 78 percent among institutions with enrollments of more than 5,000, down to 30 percent among institutions with enrollments of fewer than 700. The Pi Mu Epsilon club was particularly popular among very large institutions (more than 5,000 students), 31 percent of which had clubs with this affiliation. The predominant affiliation at institutions in the 1,500-5,000 enrollment-size category was with Kappa Mu Epsilon (12 percent).

Characteristics of club programs.--There seemed to be no significant categorical differences in the type of programs offered. Between one-third and one-quarter of all 877 institutions devoted time to each of three activities: the presentation of papers by members of the clubs, talks by faculty members, and talks by speakers from outside the institution. There was no uniformity in frequency of club meetings. Nineteen percent held only 1 to 4 meetings per academic year, while 32 percent held 5 to 7 meetings, 31 percent 7 to 10, and 18 percent, more than 10 meetings yearly.

Table 24.--Number and percent of institutions having undergraduate mathematics clubs on campus, and percent of these institutions having specified clubs; by type, control, region, and enrollment size: Aggregate United States, 1960-61

Category of institution	Number of institutions having a math club on campus	Percent having clubs (number in column 2÷ number of institutions in category)	Percent[1] of institutions having clubs which are-- Affiliated with Pi Mu Epsilon	Affiliated with Kappa Mu Epsilon	Local clubs with no affiliation	Other
(1)	(2)	(3)	(4)	(5)	(6)	(7)
All institutions.......	426	49	7	6	31	5
Type						
Universities...........	102	73	32	4	38	4
Liberal arts colleges..	241	42	3	5	29	6
Teachers colleges......	69	51	0	10	36	4
Technological schools..	14	44	6	6	28	3
Control						
Public.................	183	63	13	9	38	6
Private................	243	41	4	5	28	5
Region						
North Atlantic.........	124	48	7	2	37	3
Great Lakes and Plains.	125	46	7	10	26	4
Southeast..............	104	53	7	6	32	8
West and Southwest.....	73	48	8	6	30	3
Enrollment size						
Over 5,000.............	111	78	31	6	43	6
1,500-5,000............	123	56	6	12	35	4
700-1,499..............	114	46	1	3	35	6
Under 700..............	78	30	1	3	19	6

[1] Percents in columns 4 through 7, which are based on the total number of institutions in each category, may not add up to the number in column 3; this is because of rounding and because, in the case of larger institutions, there were instances of more than one mathematics club on campus.

Activities Other Than Clubs

A total of 473, or 54 percent of the institutions participating in the survey, reported the sponsorship of extracurricular activities other than clubs. Most popular by far among such activities was the visiting lecturer program, with 38 percent of all institutions having this program. Mathematics contests were next, with 21 percent. Only 4 percent of the institutions mailed out a newsletter or bulletin to high schools.

Comparisons by category of institution.--More than three-fourths (77 percent) of the universities sponsored one or more activities other than mathematics clubs, to stimulate undergraduate student interest in mathematics (see table 25.) Only about one-half of each of the other types of institution did so. Universities ranked high in the use of both visiting lecturers (60 percent) and mathematics contests (39 percent). Teachers colleges rated lowest in visiting lecturers (27 percent) and in mathematics contests (15 percent). Universities (9 percent) and teachers colleges (8 percent) issued newsletters and bulletins for high schools proportionately more frequently than did liberal arts colleges and technological schools. About two-thirds of the public institutions utilized one or more of these activities, whereas only about one-half of the private ones did so. Regionally, the North Atlantic institutions utilized the specified activities less than did those in other regions.

Table 25.--Number and percent of institutions sponsoring one or more activities other than mathematics clubs, to stimulate interest in mathematics at the undergraduate level and the percent of these institutions sponsoring specified activities; by type, control, region, and enrollment size: Aggregate United States, 1960-61

Category of institution	Number of institutions sponsoring such activities	Percent sponsoring such activities (number in column 2 ÷ number of institutions in category)	Percent[1] of institutions sponsoring--			
			Mathematics contests	Visiting lecturers	Newsletters or bulletins to high schools	Other
(1)	(2)	(3)	(4)	(5)	(6)	(7)
All institutions.......	473	54	21	38	4	14
Type						
Universities...........	107	77	39	60	9	15
Liberal arts colleges..	280	49	18	36	2	12
Teachers colleges......	70	51	15	27	8	21
Technological schools..	16	50	28	38	3	19
Control						
Public.................	192	66	26	42	9	19
Private................	281	48	18	36	2	11
Region						
North Atlantic.........	116	45	16	29	1	14
Great Lakes and Plains.	155	57	24	44	6	13
Southeast..............	111	56	18	39	5	13
West and Southwest.....	91	59	27	42	6	15
Enrollment size						
Over 5,000.............	110	77	41	56	6	15
1,500-5,000............	145	66	26	46	8	14
700-1,499..............	123	49	16	35	2	15
Under 700..............	95	36	11	25	2	11

[1] Percents in columns 4 through 7, which are based on the total number of institutions in each category, do not add up to the percents in column 3; this is because many institutions reported sponsoring more than one of these activities.

There was a direct relationship between size-category of institution and use of these activities; the range was from 77 percent for institutions with enrollments of more than 5,000, down to 36 percent for institutions with enrollments of fewer than 700. The use of mathematics contests and visiting lecturers was also in direct relationship to size of institution. The larger institutions, with larger student bodies and larger staffs, are probably more able to conduct the various activities.

INSTRUCTIONAL TECHNIQUES OTHER THAN THE STANDARD LECTURE (Item 13)

The traditional teaching technique in mathematics has been the lecture, usually before a class of 20 to 40 students, but expanding enrollments in recent years, the advent of television, and other factors have heightened interest in newer instructional techniques. There are a number of alternatives to exclusive dependence on the standard lecturer. Of the 877 participating institutions, 428, or 49 percent, indicated that they used one or more of the techniques listed on the questionnaire (see table 26). "Continental Classroom" was the technique most frequently used (22 percent of the institutions). Large lecture classes with help sessions were utilized by 15 percent and an organized program of independent study, by 13 percent.

Comparisons by Type of Institution

These other techniques were especially prevalent at universities; 63 percent of the

Table 26.--Number and percent of institutions using one or more instructional techniques other than the standard lecture, and percents using specified techniques; by type, control, region, and enrollment size: Aggregate United States, 1960-61

Category of institution	Number of institutions using one or more techniques other than standard lecture	Percent using one or more such techniques[1] (number in column 2 ÷ number of institutions in category)	Percent[2] of institutions using--				
			Large lecture classes with small quiz section	Large lecture classes with help sessions	Organized program of independent study	"Continental Classroom" television course	Other[3]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
All institutions.......	428	49	6	15	13	22	13
Type							
Universities...........	87	63	18	31	12	23	17
Liberal arts colleges..	267	47	4	13	15	22	12
Teachers colleges......	63	46	2	12	8	30	21
Technological schools..	11	34	12	7	9	3	16
Control							
Public........	148	51	6	17	8	28	15
Private................	280	48	6	14	15	19	12
Region							
North Atlantic.........	109	43	6	10	13	15	12
Great Lakes and Plains.	153	57	11	21	16	29	12
Southeast..............	94	47	4	16	13	21	14
West and Southwest.....	72	47	1	14	8	24	14
Enrollment size							
Over 5,000.............	90	63	18	29	11	24	25
1,500-5,000............	103	47	5	12	11	25	11
700-1,499..............	118	47	4	12	18	20	12
Under 700..............	117	44	1	14	11	20	10

[1] Percent in this column does not equal sum of percents in columns 4 through 7 because many institutions used more than one of these techniques.

[2] Based on total number of institutions in each category.

[3] Includes broadcast television courses other than "Continental Classroom," courses by closed-circuit television, and courses by film. These categories were also listed on the questionnaire form, but they were so sparsely used that statistical breakdowns by categories are not given here for them. They are discussed in the text, however.

universities--contrasted to 47 percent of the liberal arts colleges, 46 percent of the teachers colleges, and 34 percent of the technological schools--used at least one of them. As would be expected, universities led in the use of large lecture classes with help sessions (31 percent) and large lecture classes with small quiz sections (18 percent). Liberal arts colleges ranked highest in organized programs of independent study (15 percent) and teachers colleges, in "Continental Classroom" (30 percent).

Comparisons by Control

Overall, there was little difference between public and private institutions in the use of instructional techniques other than the standard lecture, with about half of the institutions in each category doing so. In comparing specific techniques, however, private institutions predominated in the use of organized programs of independent study and public institutions, in the utilization of "Continental Classroom."

Comparisons by Region

The use of other techniques was most characteristic of the Great Lakes and Plains region (57 percent) and least characteristic of the North Atlantic region (43 percent). The other regions hovered around 47 percent. The Great Lakes region led all other regions in the use of large lecture classes with small quiz sections (11 percent), large lecture classes with help sessions (21 percent), organized programs of independent study (16 percent), and "Continental Classroom" (29 percent).

Comparisons by Enrollment Size

The largest institutions (those with enrollments of more than 5,000) were most likely to employ techniques other than the standard lecture. Almost two-thirds (63 percent) of these institutions employed one or more of these techniques, whereas the corresponding percentages for the other size categories were all around 45 percent. The largest institutions were far ahead in the use of large lecture classes with help sessions (29 percent) and in the use of large lecture classes with small quiz sections (18 percent). The only other difference worth noting was between institutions in the 700-1,499 enrollment-size category (18 percent) and those in all other size-categories (11 percent each) in the use of organized programs of independent study.

Less Frequently Used Techniques

Only 14 colleges reported that they gave mathematics courses by broadcast television other than "Continental Classroom," only 13 gave them by closed-circuit television, and only 14 gave courses by film. A total of 72 institutions reported that they used instructional techniques other than those which have been specifically mentioned.

INSERVICE EDUCATION OF MATHEMATICS TEACHERS

National Science Foundation Institutes

Data obtained directly from the National Science Foundation (NSF) showed that during the academic year 1959-60 and the summer of 1960, a total of 365 NSF institutes and conferences, wholly or partly on mathematics, were attended by 11,875 mathematics teachers. A breakdown of the institutes by types shows that there were 32 academic-year institutes, attended by 600 teachers of mathematics; 6 inservice institutes, attended by 200 elementary school teachers and 120 inservice institutes, by 4,400 secondary school teachers of mathematics; 6 summer institutes attended by 225 elementary school teachers, 176 by 5,500 secondary school teachers, 13 by 500 secondary school and college mathematics teachers, and 9 by 350 college professors; and 3 summer conferences (short institutes) attended by 100 college mathematics professors.

Other Institutes (Item 16)

Inservice training programs for mathematics teachers reported in this survey included summer institutes; late-afternoon, evening, or Saturday sessions; academic-year full-time institutes; and other types, such as single courses. Of the 877 institutions participating in the study, 178, or 20 percent, offered such non-NSF programs, and a number of institutions offered more than one type.

Of the institutions with inservice programs, 46, or 26 percent, provided inservice training for elementary school teachers only; 23, or 13 percent, for junior high teachers only; 26, or 15 percent, for senior high teachers only; 24, or 13 percent, for senior high teachers only; 24, or 13 percent, for elementary school and junior high teachers; 53, or 30 percent, for junior and senior high teachers; 38, or 21 percent, for elementary, junior high, and senior high teachers; and 7, or 4 percent, for high school and college teachers. No inservice program for college teachers only was offered that was not sponsored by the National Science Foundation. The most common practice was to have inservice training programs for elementary school teachers alone and for junior and senior high teachers together.

Kinds of institutes and sponsorship.--Of the 201 institutes held at the 178 institutions, 75 institutes, or 37 percent, were summer institutes; 93, or 46 percent, late-afternoon, evening, or Saturday sessions; 4, or 2 percent, academic-year full-time institutes; and 29, or 14 percent, some other type of program.

Information on the sponsorship of the institutes was reported for 186 institutes. One hundred thirty-two, or 71 percent, were supported by the host institution itself; 22, or 12 percent, by a private corporation or foundation; 32, or 17 percent, by some other organization, such as a local school board, a religious order, or a State department of education.

Comparisons by category of institution.--Teachers colleges stood out as offering more inservice programs proportionately than any other type of institution. Forty-three, or 32 percent, of the 136 teachers colleges offered inservice programs, as compared with 31, or 22 percent, of 139 universities; 103, or 18 percent, of 570 liberal arts colleges; and 1, or 3 percent, of 32 technological schools.

A larger proportion of liberal arts colleges and teachers colleges, 48 percent and 44 percent, respectively, held summer institutes than did universities (only 23 percent). Late-afternoon, evening, and Saturday sessions were the most common types of inservice training programs in all institutions, with 63 percent of the teachers colleges, 55 percent of the universities, and 48 percent of the liberal arts colleges having these forms.

A very large proportion of liberal arts colleges (80 percent) and teachers colleges (79 percent) financed their own inservice programs largely or exclusively by themselves, as did 48 percent of the universities and the one technological school that had such a program. A much larger proportion of universities received aid for their inservice programs from private corporations or foundations than did any other type of institution, and a larger proportion of teachers colleges received aid from "other" sources, frequently from State departments of education, than did other types of institutions.

A larger percentage of publicly controlled institutions offered non-NSF inservice programs for mathematics teachers than did private ones. Of 291 public institutions, 73, or 25 percent, had these programs, as compared with 105, or 18 percent of 586 private institutions.

A larger percentage of private than of public institutions financed their own inservice programs, although the percentage was well over half for each type. A larger percentage of public than of private schools received financial assistance from "other sources" for their inservice programs.

A smaller proportion of institutions in the North Atlantic region held summer institutes than in the other regions, and a much larger proportion of institutions in this same region held late-afternoon, evening, or Saturday sessions than in the other regions. Accessibility of teachers to institutions of higher education probably influenced the type of inservice training programs offered; that is, teachers near large cities and towns with colleges would be more able to attend late-afternoon, evening, and Saturday classes than would teachers in more remote areas, for whom summer institutes would be more suitable.

LIBRARY ORGANIZATION FOR MATHEMATICS (Item 14)

Fundamental to the effectiveness of any collegiate program of instruction is a good library with a high ratio of books to students, and high percentages of recent volumes and "quality" volumes. This survey did not attempt to measure these factors, but rather, to investigate how mathematics libraries in colleges and universities were organized. Of the 877 schools in the survey, 711, or 81 percent, had no separate mathematics library. One hundred fifty-three schools, or 17 percent, indicated that they had either a separate mathematics or a combined mathematics and science library. There were 13 nonrespondents, or 1 percent, to this question. Of the institutions having separate libraries, 62, or 41 percent, had a departmental library, while 91, or 59 percent, had the combined form.

Extent of Separate Libraries, by Categories

Universities had a far larger percentage of both types of separate library than any other type of institution. Eighteen percent of the universities had mathematics department libraries; technological institutions were the closest competitor, with 9 percent (a percentage that only represented 3 institutions, however). Twenty-five percent of the universities responding to this question had a combined library, and the next largest contingent was the liberal arts colleges, with only 9 percent. Combining the two categories shows that 43 percent of the universities had separate library facilities, but only 13 percent of the liberal arts colleges, 12 percent of the teachers colleges, and 16 percent of the technological schools.

The mathematics library was slightly more prevalent at public institutions, 9 percent of which had such a library, compared to 6 percent of the private institutions. There were slight regional differences: in the North Atlantic region 12 percent of the schools had separate mathematics libraries and another 13 percent, a combined mathematics-science library; in greatest contrast to this region was the Southeast, in which 4 percent of the institutions had separate mathematics libraries and 7 percent, the combined libraries.

Enrollment size was perhaps the most relevant of the categories: separate mathematics libraries or separate combined libraries were most prevalent by far at the largest institutions.

Attitudes Toward Separate Libraries by Those Who Do Not Have Them

Of the 711 respondents that had no separate libraries, 486, or 68 percent, did not feel a need for them. Another 212 expressed dissatisfaction and their preferences (13 did not respond). Interestingly enough, the same categories in which a relatively high percentage already had such facilities also had a relatively high percentage desiring them. Of those universities without separate facilities, 52 percent desired them. Only 27 percent of the liberal arts colleges and 33 percent of the teachers colleges which did not have separate libraries were unhappy about not having them. The same relationship existed in the control categories: 40 percent of the public institutions and 26 percent of the private institutions that did not have separate facilities wanted them. Regional differences were quite small, but enrollment-size differences were significant; a desire for separate libraries was far more common among the larger schools.

General Comments

To be fully effective, a library must be conveniently located for its potential users. Reference books will be used much more often if they are readily obtainable. Thus, on large campuses especially, separate libraries are quite desirable. Of course, a separate library staff is required, but in a large enough institution the size of the separate library justifies this manner of operation.

On smaller campuses the general library is adequate, being close enough to all departments to serve them all efficiently; thus, the additional cost of operating a separate library cannot be justified. Nevertheless, at many small and middle-sized institutions, department heads have an arrangement with the head librarian whereby a number of essential books are informally assigned to the department for departmental use. Frequently a staff member or a student assistant will have responsibility for operation of this informal library.

DIGITAL COMPUTERS ON COLLEGE CAMPUSES (Item 15)

Since World War II the field of computing has been the most rapidly growing branch of mathematics. More and more persons, with varying levels of mathematical background, have been attracted to it, and indications are that greater numbers will be needed in the future.

Colleges and universities have been providing training in high-speed computing in increasing numbers. Many departments offer courses in computer programing, data processing, and numerical analysis. Many larger universities have established separate computation centers, and at these institutions, training in computing is not specifically a function of the mathematics department, although the instruction provided by the mathematics department is fundamental to a career in computing.

Because of the complexity of some institutions, complete information on the make and model number of each high-speed computer and the year of installation of each could not be furnished by department heads, and it was necessary to make direct contact with the directors of the computation centers to use other sources of information.

A list of the 158 institutions and their digital computers on campus during the Spring of 1961 is given in Appendix C. In many of the institutions which had been in the computing field for some time, newer models had replaced older ones. Many institutions had acquired their first high-speed computer within a few years of the time of the survey. The department heads of a number of institutions, principally smaller ones in metropolitan areas, mentioned that although they had no computer facilities of their own, they had use of industrial facilities nearby and that they provided courses for those interested in careers in high-speed computing. Many mathematics departments that did not have high-speed computers reported a desire for them.

A total of 27 institutions also provided information about their analog computers. A list of institutions having analog computers is not given in this publication, as it would undoubtedly be incomplete--many institutions did not mention analog computers that they may have had.

CHAPTER V

SUMMARY

This is the final, comprehensive report of a study in depth of mathematics programs in institutions of higher education that was conducted in the Winter and Spring of 1961. A total of seven preliminary publications, highlighting certain aspects of the survey, have preceded this final report. A total of 877 colleges and universities granting bachelor's or higher degrees, or about 82 percent of the 1,069 to which questionnaires were sent, participated. Both undergraduate and graduate programs were surveyed; data were solicited on types of curriculums, degrees, course offerings, credit requirements, examination requirements, special features, and innovations and trends. In addition to analysis of the data for all institutions in the survey, analysis was also made according to type, control, region, and enrollment size of institution. Unless indicated otherwise, however, the data in the following summary of highlights are to be understood as applying to all institutions reporting programs.

UNDERGRADUATE PROGRAM

Slightly over half (52 percent) of the entering freshmen enrolled in mathematics courses in Fall 1960 were in college algebra, trigonometry, or courses of an equivalent level. One-fourth were enrolled in courses of a lower level and slightly less than one-fourth in courses of a higher level. Technological schools as a type had the highest percentage of students at the higher-level courses. Private colleges as a group had proportionately more students at the more advanced level than did the public institutions. The North Atlantic region also exceeded the other regions in this respect.

The liberal arts, or general, curriculum was by far the most common kind, being offered by 87 percent of the 877 institutions participating in the survey. Fifty-nine percent of them reported having a mathematics-teaching curriculum. At most of the other institutions, however, students could generally prepare to be mathematics teacher by taking the regular mathematics curriculum and the appropriate number of courses in professional education (education courses) in order to meet teacher certification requirements. Of the types of institutions in the survey, the only type at which a student generally could not study to become a secondary school mathematics teacher was the college devoted exclusively to engineering. Only 27 institutions reported having specifically an undergraduate statistical curriculum; 7, an actuarial science curriculum; and 36, an applied mathematics curriculum.

The most common mathematics requirement in semester credit-hour requirements for a liberal arts or general curriculum is 29 to 31, with 30 being the most usual requirement. Private institutions tended to have lower credit requirements than did public institutions. In the mathematics-teaching curriculum there was a bimodal distribution in semester credit-hour requirements, with 28 percent of the institutions having a requirement in the 29-31 credit range and 26 percent in the 23-25 credit range.

Almost four-fifths (79 percent) of all institutions having a mathematic-teaching curriculum had a requirement in professional education (education courses) in the range of 17 to 25 credits. Almost one-third (32 percent) had a requirement in the 17 to 19 range (usually 18 semester credit-hours). The median requirement for all institutions was in the 20 to 22 credit range.

In a liberal arts or general curriculum, more than half (55 percent) of the institutions awarded a Bachelor of Arts (B.A.) degree only; 21 percent, a Bachelor of Science (B.S.) degree only; and 24 percent, either a B. A. or B. S. In a mathematics-teaching curriculum, about one-third offered a B. A. only; about one-third, a B. S. only; about one-seventh, a B. A. or B. S.; and one-fifth, a bachelors degree with the designation of education in it.

The liberal arts or general curriculum was the most popular curriculum, accounting for 58 percent of the bachelor's degrees awarded by all institutions. The mathematics-teaching curriculum accounted for 36 percent of the degrees; applied mathematics, for 4 percent; and statistics, for 1 percent. The fact that 36 percent of all mathematics degrees awarded were in mathematics-teaching curriculums, however, does not mean that only 36 percent of all mathematics degree-holders were qualified to teach. Actually, many of the graduates of liberal arts or general curriculums had qualified for teaching by taking appropriate professional education (education courses) at their colleges. It is estimated that between 40 and 50 percent of all recipients of bachelor's degrees in mathematics are fully qualified to teach mathematics in secondary schools.

Of the 570,954 students reported by the 877 colleges in this survey as enrolled in undergraduate mathematics courses during Fall 1960, almost two-thirds (65.6 percent) were at the freshman level; 16.6 percent at the sophomore level; and 17.7 percent at the junior and senior level. Enrollment figures showed that college algebra, with an enrollment of 82,125 students, or 21.9 percent of the freshman mathematics enrollment, was the most popular freshman course, and that analytic geometry and calculus (offered by 41 percent of the institutions) was second with 50,874, or 13.6 percent of the total. Mathematical analysis was next with 46,151 students, or 12.3 percent of the total freshman enrollment. The intergrated course, analytic geometry and calculus, was the most popular sophomore course, accounting for 39.0 percent of the total sophomore-year enrollment. At the junior and senior level the course offered by the most institutions (74 percent of them) was advanced calculus, but the greatest enrollment was in ordinary differential equations, which accounted for 15.0 percent of the total mathematics enrollment at this level. A great variety of courses were offered at the junior and senior level; 43 different courses were cited with sufficient frequency to be listed in the table on enrollments in the various courses.

Fifty-eight percent of all institutions offered at least one course in what they considered remedial mathematics. About one student in seven taking freshman-year mathematics was enrolled in such a course. Almost three-fourths of the public institutions offered such instruction whereas only one-half of the private institutions did so. Intermediate algebra was the subject most frequently given as prerequisite instruction. Only a small percentage of institutions offered college algebra or trigonometry as remedial instruction. A total of 84, or 23 percent, of the 369 institutions which were not at the time of the survey offering prerequisite instruction as part of their program had offered it some time during the preceding 10 years. The reasons most commonly given for discontinuing this instruction were better high school preparation of students, the belief that such instruction more properly belongs in the high school or should be an extension activity, and the shortage of faculty.

Seventy-five percent of the institutions participating in the survey reported that they required an admissions examination that included mathematics. The College Entrance Examination Board (C.E.E.B.) test was the most commonly used. Private institutions required admissions examinations involving mathematics more than did public institutions, and institutions in the North Atlantic region required such examinations more than did other regions.

Fifty-nine percent of the institutions reported that they administered a mathematics placement examination. More than half (54 percent) of those which gave such examinations required them of all entering freshmen. Twenty-nine percent restricted the examination to students taking mathematics in college for the first time and 14 percent only to students in special curriculums, such as engineering. Algebra (88 percent) is the subject most commonly tested for; half of the institutions test for geometry and half for trigonometry. The most common objective of the placement examination (70 percent of the responses) was to determine the specific course in which to enroll the student. Public institutions (71 percent) required placement examinations more than did private institutions (53 percent).

Of the 877 institutions in the survey, 589, or 67 percent, had programs of advanced standing. Of these, 310, or 53 percent, gave college credit toward graduation for courses for which students had met the requirements through previous study. Fifty-five percent of the 310 institutions gave credit for college algebra; 54 percent, for trigonometry; 52 percent, for analytic geometry; 51 percent, for calculus; and 14 percent, for some other subject. Institutions frequently used more than one method of determining advanced standing. Twenty percent of the institutions having programs of advanced standing admitted students to these programs on the basis of recommendation by the high school; 48 percent, on the basis of a locally constructed proficiency examination; 37 percent, in accordance with scores made on a nationally distributed proficiency examination; and 17 percent, by some other measures. Universities offered programs of advanced standing more than did other types and also took the lead in the percentage giving college credit for courses skipped.

A total of 266 (30 percent) of the 877 respondents in the survey had an honors program. A breakdown of the 266 by categories shows that 60 percent of the universities, 27 percent of the liberal arts colleges, 15 percent of the teachers colleges, and 16 percent of the technological instituties in the study offerred a special program. The size of the institution seemed a very important factor, since 57 percent of the largest institutions (more than 5,000 students) offered a program, while only 17 percent of the smallest institutions (fewer than 700 students) did so. The most prevalent kind of honors program was independent study.

A total of 142, or 16 percent, of all institutions in the survey required an undergraduate thesis in mathematics of some or all mathematics majors. Fifty-five percent of these institutions required it of honors students only; 40 percent, of all mathematics students; and 5 percent, of other types of students. Private institutions (21 percent) required theses of at least some students more often than did public institutions (7 percent). The North Atlantic region was way ahead of other regions in requiring undergraduate theses in mathematics, almost one in four (24 percent) of the institutions in this region having this requirement.

One-third of the institutions in the survey required each student to take at least one mathematics course of college level prior to graduation. Public institutions (44 percent) had such a requirement more than did private institutions (28 percent). This requirement was much more common among institutions in the North Atlantic region (59 percent) than in institutions in the other regions.

There were many changes in mathematics curriculums in colleges and universities from 1950 to 1961. The most commonly adopted innovation of the eight listed on the questionnaire was the substantial expansion in course offerings (by 59 percent of the institutions). Next most frequent was the introduction of freshman courses emphasizing such concepts as mathematical structure, logic, and set theory (47 percent). Changes in, or introduction of, a program for the undergraduate preparation of mathematics teachers were made by 36 percent of the responding institutions.

A little less than half of the respondents (48 percent) accepted the invitation to make comments about their mathematics programs. Of these, 24 percent discussed the problem of the mathematics department's being a service department for other departments, and 25 percent discussed the problem of upgrading or modernizing the mathematics curriculum. Eleven percent made comments on problems relating to faculty. Many of these felt that their faculties were inadequate to the various tasks that were being imposed on their departments.

GRADUATE PROGRAMS

Master's Programs in Mathematics

Data were obtained on 220 master's programs, or more than 95 percent of the universe of master's programs in mathematics. A student could receive a Master of Arts (M.A.) degree at approximately 68 percent, and a Master of Science (M.S.) degree at approximately 57 percent, of the reporting institutions. (Either the M.A. or the M.S. could be obtained at a number of the institutions.)

The number of required credit-hours in mathematics for institutions on a semester-hour basis ranged from 12 to 36, both the median and the mode being 24 semester-hours. The total number of required credits for the degree ranged from 18 to 38 semester-hours, the median and the mode both being 30 semester hours. In 26 percent of the programs, the entire credit requirement for the degree was in mathematics. In 52 percent of the programs a thesis was required; in 35 percent, it was optional; and in 13 percent, no provision at all was made for a thesis. A modern foreign language was required in 45 percent of the programs.

It was possible to earn the master's degree in mathematics by evening and/or Saturday study at 59, or 27 percent, of the 220 reporting institutions and through summer study alone at 82, or 37 percent, of them.

A final comprehensive examination was required at 88 percent of the institutions, was optional at 1 percent, and was not provided for at 11 percent. Of the institutions requiring comprehensive examinations, 59 percent insisted upon only an oral examination; 13 percent, only a written examination; and 27 percent, both oral and written examinations.

Twenty-five percent of the respondents reported that a minor was required; 35 percent, that a minor was optional; and 44 percent, that no provision was made for a minor. (Percentages do not add to 100 percent, since some institutions may have various requirements among programs teaching to the same degree.)

Sixty-eight percent of the respondents reported that a minor in mathematics was available to those majoring in other departments. In 33 mathematics departments minors were offered in conjunction with a master's degree in another department even though the mathematics department made no provision for a minor for its own degree candidates.

Master's Programs Specially Designed for Teaching

Data were obtained on 183 master's programs specially designed for the teaching of mathematics. In 45 percent of the programs, a student could earn an M.A. degree in some form; in 40 percent, an M.S. degree; and in 27 percent, an Education degree. (Some institutions provided for variations within a given program and as a result offered more than one type of degree for the same program.) Of the 81 institutions awarding a Master of Arts degree, 39 conferred a straight M.A.; 28, a Master of Arts in Teaching (M.A.T.); and 9, a Master of Arts in Education. The most common Education degree was the Master of Education (M. Ed.), conferred by 38 institutions.

The required number of credit-hours in mathematics among institutions on a semester-hour basis ranged from 6 to 36, both the median and the mode being 18 semester-hours. Twenty-six institutions reported that they had no specific credit requirements for education courses. Among institutions on a semester-hour basis that had a requirement in education courses, the requirement ranged from 2 to 26, with a median of 10 semester-hours and a mode of 6 semester-hours. The range in total credit requirements for the degree was 24 to 36 semester-hours, the median and the mode both being 30. In 21 percent of the programs a thesis was required; in 40 percent, it was optional; and in 38 percent, no provision was made for a thesis. A modern foreign language was a requirement in only 9 percent of the programs.

It was possible to earn the master's degree by evening and/or Saturday study in 55, or 30 percent, of the 183 reporting institutions and through summer study alone in 135, or 74 percent of them.

At 75 percent of the responding institutions a final comprehensive examination was required. Of these institutions, 38 percent insisted upon only an oral examination; 29 percent, a written examination; and 31 percent, both oral and written examinations.

A minor was required in 24 percent of the programs and was optional in 27 percent of them.

Doctoral Programs in Mathematics

Data were obtained from 94 institutions offering doctoral programs in mathematics in 1961, or 100 percent of the universe of doctoral programs. Several of the respondents indicated that plans were underway to inaugurate doctoral programs at their institutions.

The total number of credit-hours required for the degree was reported by 57 institutions, 47 on the semester plan and 10 on the quarter plan. The remaining 37 institutions had no specified minimum number of credits. Of the 47 institutions on the semester plan, 26 included the credits earned for the thesis in the reported total degree-credit requirements. At these institutions the total required number of semester-hours ranged from 36 to 96, the mode being 90 semester-hours. Twenty-one institutions on a semester plan reported total credit-hour requirements without including thesis credits. These requirements ranged from 48 to 90 semester-hours plus a thesis, the mode being 60 semester-hours. The minimum credit-hour requirements in mathematics varied considerably from institution to institution. For institutions on a semester-hour basis, the minimum number of semester-hours in mathematics ranged from 36 to 96, with the mode of 60 semester-hours.

All but two institutions had more than one kind of examination in partial fulfillment of the doctoral degree. Twenty-six percent required two kinds of examinations; 49 percent, three kinds; 14 percent, four kinds; and 9 percent, five kinds. Seventy-six percent of the institutions required candidates to take an oral preliminary or qualifying examination; 63 percent, a written preliminary or qualifying examination; 45 percent, a final comprehensive oral examination; 22 percent, a final comprehensive written examination; 97 percent, an oral examination on thesis; and 1 percent, an examination on a minor thesis in mathematics.

Competence in two modern languages was required in all programs with the exception of two programs at Harvard University (statistics and applied mathematics, which required only one foreign language). All 93 institutions which reported on their foreign language requirements accepted German and French; 90, Russian; 13, Italian; 3, Japanese; and 1, Spanish.

Thirty-five percent of the institutions reported that a minor was required; 31 percent, that a minor was optional; and 33 percent, that no provisions were made for a minor.

At nine institutions it was possible for a student to earn a doctor's degree in mathematics entirely through evening and/or Saturday study. At four institutions the degree could be earned entirely through summer study.

The 94 institutions awarded a total of 864 doctor's degrees in mathematics from January 1958 to January 1961, inclusive. Analysis was the most popular specialization, being offered at 85 of the institutions and accounting for 304 doctor's degrees, or more than a third of the total number. Algebra was the next most popular in terms of the point of number of institutions offering it (76), but accounted for only 110 degrees whereas statistics, offered by 49 institutions, claimed 164 degrees over the 3-year period. Applied mathematics (114 degrees) and topology (94 degrees) also accounted for sizable portions of the 864 degrees conferred.

Doctoral Programs Specially Designed for Teaching

In 1961 twenty-five institutions offered a doctoral program specially designed for the teaching of mathematics. Four of these programs had only recently been introduced.

The Doctor of Philosophy (Ph.D.) degree was the only degree offered for this program at 8 of the 25 institutions; the Doctor of Education (Ed.D.), the only degree in 6 others; and either the Ph.D. or Ed.D in the remaining 11.

The credit-hour requirements in mathematics at the 13 reporting institutions on the semester plan ranged from 24 to 60 semester-hours, with a median of 34 and a mode of 30. Semester-hour requirements in education courses ranged from 9 to 48 semester-hours, with a median of 30. The total number of semester-hours required for the degree ranged from 60 to 96, with a mode of 90.

Of the 22 institutions reporting examinations required in partial fullfillment of the doctoral degree, 15 required an oral preliminary or qualifying examination; 16, a written preliminary; 14, a final comprehensive oral examination; 11, a final comprehensive written examination; and 22, an oral examination on the thesis. Three of the 22 institutions insisted upon 2 of these examinations; 6, upon 3; 9, upon 4; and 4, upon 5.

Of 18 responding institutions with Ph.D. teaching programs, 16 required competence in two modern foreign languages, and two required only one. Of the 15 responding institutions offering the Ed.D. degree, none required two languages for the degree, and only two institutions required one language. Of the 17 institutions indicating which languages were acceptable in meeting the requirement, all 17 accepted German and French; 14 Russian; 4, Italian; 2, Spanish; and 1, Romance languages.

Of 20 institutions which answered the question on minors, 12 reported that a minor was required for at least one of the doctoral degrees in programs specially designed for the teaching of mathematics; 4, that a minor was optional; and 4, that no provision for a minor was made.

At only one institution could a student earn his doctoral degree through Saturday and/or evening study and at three, through summer study.

A total of 63 doctor's degrees specially designed for the teaching of mathematics were awarded during the period from January 195 to January 1961, inclusive.

Additional Preparation for College Teaching

A total of 64 departments in 63 different institutions reported some arrangements for preparing college teachers, such as professional courses in education, seminars, and supervised teaching experience. However, there were actually more programs in American colleges and universities than the responses indicated because the respondents in some of the larger universities were not aware of all the programs at their institutions.

Of the 59 respondents who commented on their programs, 13 said that education courses and/or teaching seminars were required of prospective teachers; 21, that they were not required but encouraged; and 25, that they were neither required nor particularly encouraged.

SOME RELATED FACTORS

Almost half (49 percent) of the 877 institutions participating in this survey had an undergraduate mathematics club on campus. Thirty-one percent of the 877 institutions had local clubs with no affiliation. Seven percent had clubs affiliated with Pi Mu Epsilon and 6 percent, with Kappa Mu Epsilon. There was a direct correspondence between enrollment size and undergraduate clubs on campus, ranging from 78 percent of the institutions with more than 5,000 students down to 30 percent of the institutions with fewer than 700 students.

Better than three-quarters (77 percent) of the universities sponsored one or more activities, other than mathematics clubs, to stimulate undergraduate student interest in mathematics. Only about half of each of the other types of institutions did so. These other activities consisted primarily of mathematics contests and visiting lecturers.

Forty-nine percent of the institutions used one or more instructional techniques other than the standard lecture before a class typically consisting of 20 to 40 students. "Continental Classroom" was the technique most frequently used (22 percent of the institutions). Large lecture classes with help sessions were utilized by 15 percent of the institutions and an organized program of independent study, by 13 percent. These other techniques were especially prevalent at the universities, as 63 percent of the universities, contrasted to 47 percent of the liberal arts colleges, 46 percent of the teachers colleges, and 34 percent of the technological institutes, used at least one of them.

Of the 877 institutions participating in the survey, 178, or 20 percent, offered inservice institutes for mathematics teachers other than those sponsored by the National Science Foundation. Of the 201 institutes at the 178 institutions, 37 percent were summer institutes; 46 percent, late-afternoon, evening, or Saturday session institutes; 2 percent, academic year full-time institutes; and 29, or 14 percent, some other type of program. Seventy-one percent of the institutes were financially supported by the host institutions themselves; 12 percent, by private corporations or foundations; and 17 percent, by some other group or organization, such as a local school board, a religious order, or a State department of education. Teachers colleges stood out as offering more of these inservice programs proportionately than any other type of institution.

Seventeen percent of the institutions in the survey had a separate library, separate from the main library, for mathematics alone or for mathematics and one or more sciences alone. Of the institutions possessing separate libraries, 41 percent had the library for mathematics alone and 59 percent had a library for mathematics combined with one or more of the sciences. Of institutions without such separate facilities, only 30 percent desired them, with universities (52 percent) leading in this respect.

In Spring 1961, a total of 158 institutions had high-speed digital computers on their campuses. In many of the institutions which had been in the computing field for some time, newer models had replaced olders models. Many institutions reported that they had acquired their high-speed computer only recently. The department heads of a number of institutions, principally smaller ones in metropolitan areas, mentioned that although they had no computer of their own, they had use of industrial facilities nearby and that they provided courses for those interested in careers in high-speed computing. Many departments were feeling the need and desire for high-speed computers.

APPENDIXES

APPENDIX A. MASTER'S PROGRAMS

In Mathematics: Institutions, program requirements, program characteristics, 1961

Explanation and abbreviations:

M.-Master; A.-Arts; S.-Science; Appl.-Applied; Not spec.-Not specified; req.-required; opt.-optional.

Absence of an entry in column (6) means that no provision is made for the writing of a thesis.

An "x" in column 7 means that a modern foreign language is required for the degree.

An "x" in column 8 means that it is possible to earn the degree through evening and/or Saturday study alone.

An "x" in column 9 means that it is possible to earn the degree through summer study alone.

An asterisk * means that information relative to that item was not supplied by the respondent.

State	Institution and City	Degree(s) awarded	Credit requirement (inc. credit for thesis) s. semester; q. quarter		Thesis	Foreign language req.	Degree can be obtained by	
			In Math.	Total for the deg.			Eve. and/ or Sat. study	Summer study
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Ala.	Auburn University, Auburn........	M.S.	30q	45q	req.			x
	University of Alabama, University	M.A.	24s	30s	opt.			x
Alaska	University of Alaska, College....	M.S.	25-30s	30s	req.	x		
Ariz.	Arizona State University, Tempe..	M.A.	30s	30s	opt.	x	x	x
	University of Arizona, Tucson....	M.S., M.A.	30s, M.S.	30s		x, M.S.		
Ark.	University of Arkansas, Fayetteville.........................	M.A., M.S.	18s 18s	30s	opt.			x
Calif.	California Institute of Technology, Pasadena...............	(*)	15 quarter courses	(*)	opt.			
	Fresno State College, Fresno.....	M.A., M.S.	21s	30s		x		
	George Pepperdine College, Los Angeles....................	M.A.	30s	(*)	req.	x		
	Long Beach State College, Long Beach.....................	M.A.	18s	30s	opt.	x		
	Los Angeles State College, Los Angeles....................	M.A.	24s	30s	opt.		x	
	Pomona College and Claremont Grad. Sch., Claremont..........	M.A.	24s	30s	req.			
	Sacramento State College, Sacramento.....................	M.S., M.A.	30s, M.S. 20s, M.A.	36s, M.S. 30s, M.A.	opt.			
	San Diego State College, San Diego......................	M.A., M.S.	24s	30s	opt.	x,M.A.	x	
	San Francisco State College, San Francisco..................	M.A.	24s	30s				
	San Jose State College, San Jose	M.A., M.S.	24s	30s	opt.			
	Stanford University, Stanford, Palo Alto......................	M.S.	30-36q	45q	opt.			
	University of California at Berkeley.........................	M.A. Math.,Stat.	24s, Math. 18s, Stat.	24s	req. Statistics			
	University of California at Davis..........................	M.A. in Math.	24s	24s				
	University of California at Los Angeles....................	M.A.	24s	24s	opt.	x		
	University of California at Santa Barbara..................	M.A.	24s	24s				
	University of Southern California, Los Angeles....................	M.A., M.S.	18s	30s		x,M.A.	x	
Colo.	Colorado State College, Greeley..	M.A.	35q	45q	opt.			x
	Colorado State University, Fort Collins...................	M.S.	35q	45q	req.			x
	University of Colorado, Boulder..	M.A.	20s	24s	req.	x		x
	University of Colorado, (Appl. Math.), Boulder................	M.S. in Appl. Math.	22-28s	26-32s	opt.		x[1]	
	University of Denver, Denver.....	M.A.	45q	45q	opt.			
Conn.	Trinity College, Hartford........	M.S.	24s	30s		x		
	University of Connecticut, Storrs	M.A., M.S.	24s	24s	opt.			
	Yale University, New Haven.......	M.A.	approx. 26s	approx. 26s	opt.	x		
Del.	University of Delaware, Newark...	M.A., M.S.	30s	30s	req.		x	
D.C.	American University..............	M.A.	30s	30s	req.		x	
	Catholic University of America...	M.A., M.S.	24s	30s	req.	x		x
	George Washington University.....	M.A., M.S.	30s, Math.	30s	req.	x	x	
	Georgetown University............		18s, Stat.					
	Georgetown University............	M.A.	24s	24s	req.	x	x	
	Howard University................	M.S.	30s	30s	req.	x		
Fla.	Florida State University, Tallahassee....................	M.A., M.S.	21s	30s	opt.			
	University of Florida, Gainesville..........................	M.A., M.S.	24s	30s	req.	x		x[1]

[1] May be obtained by resident extension class work in Denver.

APPENDIX A. MASTER'S PROGRAMS

In Mathematics: Institutions, program requirements, program characteristics, 1961--Continued

State	Institution and City	Degree(s) awarded	Credit requirement (inc. credit for thesis) s. semester; q. quarter		Thesis	Foreign language req.	Degree can be obtained by	
			In Math.	Total for the deg.			Eve. and/or Sat. study	Summer study
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fla.	University of Miami, Coral Gables	M.S.	18-30s	30s				
Ga.	Atlanta University, Atlanta	(*)	24s	24s	req.	x		x
	Emory University, Atlanta	M.A., M.S.	45q	45q	req.	x		
	Georgia Institute of Technology, Atlanta	M.S. in Appl. Math.	18s plus thesis	33s plus thesis	req.			
	University of Georgia, Athens	M.A.	45q	45q	req.	x		
Hawaii	University of Hawaii, Honolulu	M.A.	18s	30s	req.			
Ida.	University of Idaho, Moscow	M.S.	24s	30s	req.	x		
Ill.	DePaul University, Chicago	M.S.	(*)	36s	opt.		x	x
	Illinois Institute of Technology	M.S.	32s	32s	req.		x	
	Illinois State Normal University, Normal	M.S. in Educ.	20s	32s	req.[2]			x
	Loyola University, Chicago	M.A., M.S.	30s	30s	opt.		x	x
	Northern Illinois University De Kalb	M.S.	23s	32s	req.		x	x
	Northwestern University, Evanston	M.A., M.S.	36q	36q			x	x
	Southern Illinois University, Carbondale	M.A., M.S.	30q	48q	req. of M.A.	x		
	University of Chigago, Chicago	S.M.	30q	(*)		x		
	University of Illinois, Urbana	M.A., M.S.	18s	24s	opt.			x
	Western Illinois University, Macomb	M.S.	36q	48q				x
Ind.	Ball State Teachers College, Muncie	M.A., M.S.[3]	32q	45q	opt.	x, M.A.	x	x
	Earlham College, Richmond	M.A.	18q	30q				
	Indiana State Teachers College, Terre Haute	M.A., M.S.	20-30s	32s	opt.		x	x
	Indiana University, Bloomington	M.A.	30s	30s		x		
	Purdue University, Lafayette	M.S.	21s	33s	opt.			
	Rose Polytechnic Institute, Terre Haute	M.S.	18s	30s	req.		x	
	University of Notre Dame, Notre Dame	M.S.	30s	30s	opt.			x
Iowa	Iowa State University, Ames	M.S.	30q	approx. 45q	req.	x		
	State University of Iowa, Iowa City	M.S.	(*)	30-38s	opt			x
Kans.	Fort Hays Kansas State College, Hays	M.A.	20s	30-32s	req.			x
	Kansas State College of Pittsburg, Pittsburg	M.A., M.S.	20s	M.A., 30s M.S., 32s	(4)	x, M.A.		x
	Kansas State Teachers College, Emporia	M.A.	20s	30s	req.			x
	Kansas State University, Manhattan	M.S.	20-26s	32s	req.			x
	University of Kansas, Lawrence	M.A.	30s	30s	req.			
	University of Wichita, Wichita	M.A.	15s	30s	req.			
Ky.	University of Kentucky, Lexington	M.A., M.S.	24s	24s	req.	x		x
	University of Louisville, Louisville	M.A.	18s	30s	req.		x	
La.	Louisiana Polytechnic institute, Ruston	M.A.	21s	30s	req.		x	x
	Louisiana State University, Baton Rouge	M.S.	30s	30s	req.			
	Northwestern State College, Natchitoches	M.S.	30s	30s	opt.			x
	Tulane University, New Orleans	M.S.	36s	36s		x		
Me.	University of Maine, Orono	M.A.	30s	30s	req.			x
Md.	Johns Hopkins University, Baltimore	M.A.	Not spec.	Not spec.		x[5]		
	University of Maryland, College Park	M.A.	18s	30s	req.[6]	x		

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[2] Or two papers.

[3] Also an M.A. in Ed. and an M.S. in Ed.

[4] A thesis is required for the M.A. degree, optional for the M.S. degree.

[5] A reading knowledge of both French and German is required.

[6] Also available is an option allowing substitution of an expository paper instead of a thesis. This requires 9 extra credit hours of course work, 33 hours in all.

APPENDIX A. MASTER'S PROGRAMS

In Mathematics: Institutions, program requirements, program characteristics, 1961--Continued

State	Institution and City	Degree(s) awarded	Credit requirement (inc. credit for thesis) s. semester; q. quarter		Thesis	Foreign language req.	Degree can be obtained by	
			In Math.	Total for the deg.			Eve. and/ or Sat. study	Summer study
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Mass.	Boston College, Chestnut Hill...	M.A.[7]	30s	30s	req	x		
	Boston University, Boston.......	M.A.	20s	30s	req.		x	
	Brandeis University, Waltham....	M.S.	18s	18s		x		
	Clark University, Worcester.....	M.A.	30s	(*)	req.	x		
	Harvard University, Cambridge...	A.M.	12s	(*)		x		
	Lowell Technological Institute, Lowell........................	M.S.	18s	30s	req.	x		
	Massachusetts Institute of Technology, Cambridge..........	S.M.	18s	24s	req.			
	Northeastern University, Boston..	M.S.	20s	30s			x	
	Smith College, Northampton.......	M.A.	24s	24s	req.	x		
	University of Massachusetts, Amherst........................	M.A.	24-30s	30s	opt.			
Mich.	Andrews University, Berrien Springs........................	M.A.	18s	18s	opt.	x		
	Central Michigan University, Mount Pleasant.................	M.A.	20-24s	30s	opt.		x	x
	Michigan State University, East Lansing........................	M.A., M.S.	33q	45q	opt.			x
	University of Detroit, Detroit...	M.A.	30s	30s	opt.	x	x	x
	University of Michigan, Ann Arbor	M.A., M.S.	18s	24s	opt.			x
	Wayne State University, Detroit..	M.A.	26s	32s	(*)	(*)	x	x
Minn.	Mankato State College, Mankato...	M.S.	27q	45q	req.			x
	University of Minnesota, Col. of LSA, Minneapolis...............	M.A., M.S.	27q	36-45q	opt.	x		x
	University of Minnesota, Inst. of Technology, Minneapolis.....	M.S.	18-21q	27-45q	opt.	x		
Miss.	Mississippi Southern College, Hattiesburg....................	M.A., M.S.	46q	46q	(8)	x		x
	Mississippi State University, State College..................	M.A., M.S.	24s	30s	req.			x
	University of Mississippi, University.....................	M.A., M.S.	30s	30s	req.			
Mo.	Central Missouri State College, Warrensburg....................	M.A.	26s	32s				x
	St. Louis University, St. Louis..	M.A., M.S.	(*)	24s	req.	x		
	University of Kansas City, Kansas City....................	M.A., M.S.	18s	30s	opt.		x	
	University of Missouri, Columbia.	M.A.	26-32s	32s	opt.			
	Washington, University, St. Louis	M.A.	24s	24s	req.			
Mont.	Montana State College, Bozeman...	M.S.	30q	30-45q	opt.	(9)		x
	Montana State University, Missoula......................	M.A., M.S.	30q	45q	req.	x		x
Nebr.	University of Nebraska, Lincoln..	M.A., M.S.	24s	30-36s	opt.			
Nev.	University of Nevada, Reno.......	M.A., M.S.	18s	30s	req.	x		
N.H.	Darmouth College, Hanover........	M.A.	30s	30s		x		
	University of New Hampshire, Durham.........................	M.S.	30s	30s				
N.J	Fairleigh Dickinson University, Rutherford.....................	M.S.	32s	32s	opt.		x	
	Rutgers The State University, New Brunswick.................	M.S.	24s	30s	opt.		x	
	Stevens Institute of Technology, Hoboken........................	M.S.	20s	30s	opt.		x	
	Trenton State College, Trenton...	M.A.	26s	32s	opt.			
N.M.	Eastern New Mexico University, Portales.......................	M.A.	27s	30s	req.	x		x
	New Mexico Highlands University, Las Vegas......................	M.S.	36q	48q	req.			
	New Mexico Institute of Mining and Technology, Socorro........	M.S.	24s	30s	req.	x		
	New Mexico State University, University Park................	M.S.	30s	30s	opt.			
	University of New Mexico, Albuquerque....................	M.S.	21s	32s	opt	x	x	x

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[7] A nonresearch M.A., in which no thesis or language is required, is offered primarily for students in National Science Foundation Institutes.

[8] A thesis is required for the M. A. degree, optional for the M. S. degree.

[9] One language is required for Plan A, which is the thesis plan with 30 credits. No language is required for Plan B, which requires 45 credits and no thesis.

APPENDIX A. MASTER'S PROGRAMS

In Mathematics: Institutions, program requirements, program characteristics, 1961--Continued

State	Institution and City	Degree(s) awarded	Credit requirement (inc. credit for thesis) a. semester; q. quarter		Thesis	Foreign language req.	Degree can be obtained by	
			In Math.	Total for the deg.			Eve. and/or Sat. study	Summer study
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
N.Y.	Adelphi College, Garden City.....	M.S.	24s	36s	opt.		x	
	Brooklyn College, Brooklyn.......	M.A.	21s	30s plus thesis	req.		x	
	City College, New York...........	M.S.	18s	30s	opt.	x	x	
	Columbia University, Columbia College, New York..............	M.A.	24s	30s	opt.	x		
	Cornell University, Ithaca.......	M.A.	Not spec.	Not spec.	req.	x		
	Fordham University, New York.....	M.A.	30s	30s	opt.	x		
	Hofstra College, Hempstead, Long Island....................	M.A. in Nat. Sci.	21s	33s	opt.	x	x	
	Manhattan College, New York......	M.A.	18s	24s plus thesis	req.	x	x	x
	New York University, New York....	M.S.	24s	30s	req.		x	
	Polytechnic Institute of Brooklyn, Brooklyn.............	M.S.	20s	30s	req.	x	x	
	Rensselaer Polytechnic Institute, Troy...........................	M.S.	21-30s	30s	opt.	x		
	St. John's University, Jamaica...	M.A.	30s	30-33s	opt.	(10)	x	x
	Syracuse University, Syracuse....	M.A., M.S.	21s	30s	opt.			
	Union College and University, Schenectady....................	M.S.	24s	30s	req.		x	
	University of Buffalo, Buffalo...	M.A.	26s	32s	req.	x	x	
	University of Rochester, Rochester......................	A.M.	32s	32s				x
	Yeshiva University, New York.....	M.A.	24s	30s			x	
N.C.	Appalachian State Teachers College, Boone.................	M.A.	30-45q	45q	opt.			x
	Duke University, Durham..........	M.A.	24s	30s	req.	x		x
	East Carolina College, Greenville	M.A., M.S.	27q	45q	req.		x	x
	University of North Carolina, Chapel Hill....................	M.A.	24s	30s	req.	x		x
	University of North Carolina, Raleigh........................	M.S. in Appl. Math.	20s	30s	req.	x		
	Wake Forest College, Winston-Salem..........................	M.A.	24s	30s	req.	x	x	x
N.D.	North Dakota State University, Fargo..........................	M.S.	30q	45q	opt.			
	University of North Dakota, Grand Forks.....................	M.A., M.S.	15-20s	30s	req.	x,M.A.	x	
Ohio	Bowling Green State University, Bowling Green..................	M.A.	15s	33s	opt.			
	Case Institute of Technology, Cleveland......................	M.S.	24s	30s				
	John Carroll University, Cleveland......................	M.S., M.A.	30s	30s	opt.	x[11]		
	Kent State University, Kent......	M.A.	23q	48q	req.			x
	Miami University, Oxford.........	M.A., M.S.	21s	30s	req.			
	Ohio State University, Columbus..	M.A., M.S.	45q	45q	req.			x
	Ohio University, Athens..........	M.S.	23-32s	32s	req.			
	University of Cincinnati, Cincinnati.....................	M.A.	30s	30s	req.	(12)		
	University of Dayton, Dayton.....	M.S.	24s	30s	opt.		x	
	University of Toledo, Toledo.....	M.A., M.S.	18s	30s	req.			
	Western Reserve University, Cleveland......................	M.A., M.S.	30s	30s	opt.			
	Xavier University, Cincinnati....	M.S.	30s	(*)	x,Plan A		x	x
Okla.	Oklahoma State University, Stillwater.....................	M.S.	32s	30-32s	opt.			
	University of Oklahoma, Norman...	M.A., M.S.	20-26s	30s	opt.			
	University of Tulsa, Tulsa.......	(*)	30s	30s	req.			
Ore.	Oregon State University, Corvallis......................	M.A., M.S.	30q	45q	req.	x,M.A.		x
	University of Oregon, Eugene.....	M.A., M.S.	(*)	45q	opt.	x,M.A.		

[10] A foreign language is required in Plan A along with a thesis and a total of 30 credits: no language in Plan B which requires a total of 33 credits and no thesis.

[11] A test in basis statistics (10 problems in 1 1/2 hours) may be substituted for foreign language.

[12] One modern language is required in the college of Arts and Sciences program; none in the College of Engineering.

APPENDIX A. MASTER'S PROGRAMS

In Mathematics: Institutions, program requirements, program characteristics, 1961--Continued

State	Institution and City	Degree(s) awarded	Credit requirement (inc. credit for thesis) a. semester; q. quarter		Thesis	Foreign language req.	Degree can be obtained by	
			In Math.	Total for the deg.			Eve. and/ or Sat. study	Summer study
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pa.	Bryn Mawr College, Bryn Mawr	M.A.	2. yr. courses	3 yr. courses	req.	x[13]		
	Bucknell University, Lewisburg	M.A., M.S.	18s	30s	opt.	x, M.A.		
	Carnegie Institute of Technology, Pittsburgh	M.S.	21s	32s	opt.			
	Duquesne University, Pittsburgh	M.A.	30s	30s	req.	x	x	
	Lehigh University, Bethlehem	M.S.	18s	30s	req.			
	Pennsylvania State University, University Park	(*)	21s	30s	req.			x
	Temple University, Philadelphia	M.A.	(*)	(*)	opt.		x	
	University of Pennsylvania, Philadelphia	M.A.	24s	24s	opt.			
	University of Pittsburgh, Pittsburgh	M.A., M.S.[14]	18s	30s	req.		x	x
	Villanova University, Villanova	M.A.	24s	30s	opt.		x	x
P. R.	University of Puerto Rico, Mayaquez	M.A.	(*)	30s	opt.	x		
R. I.	Brown University, Providence	M.A.	24s	24s	req.	x		
	University of Rhode Island, Kingston	(*)	30s	30s	req.			
S.C.	Clemson College, Clemson	M.S.	24s	30s	opt	x		
	University of South Carolina, Columbia	M.A., M.S.	30s	30s	req.	x		x
S.D.	South Dakota School of Mines and Technology, Rapid City	M.S.	24s	30s	req.			
	South Dakota State College, Brookings	M.S.	30q	45q	req.			x
	State University of South Dakota, Vermillion	M.A., M.N.S.	19s, M.A. 18s, M.N.S.	28s, M.A. 35s, M.N.S.	req., M.A.			x
Tenn.	East Tennessee State College, Johnson City	M.S.	30q	45q	req.		x	
	George Peabody College for Teachers, Nashville	M.A.	24-36q	48q	opt.			x
	Middle Tennessee State College, Murfreesboro	M.A.	15s	32s	opt.		x	x
	University of Tennessee, Knoxville	M.A.	36q	45q	req.			
	Vanderbilt University, Nashville.	M.A., M.S.	18s	24s	req.	x		
Texas	Abilene Christian College, Abilene	M.A.	18-24s	30s	req.	x		
	Agricultural and Mechanical College of Texas, College Station	M.Sc.	20s	32s	req.			x
	Baylor University, Waco	M.A., M.S.	18-30s	30s	req.	x	x	x
	North Texas State College, Denton	M.A., M.S.	24s	30s	req.	x		x
	Prairie View Agricultural and Mechanical College Prairie View	M.S.	21s	30s	req.			x
	Rice University, Houston	M.A	4 adv. courses	4 adv. courses	req.	x		
	St. Mary's University, San Antonio	M.S.	36s	36s	opt.		x	
	San Houston State Teachers College, Huntsville	M.A., M.S.	18s, M.A. 24s, M.S.	30s, M.A. 36s, M.S.	req.	x		x
	Southern Methodist University, Dallas	M.A., M.S.	24s	30s	opt.	x	x	
	Stephen F. Austin State College, Narcogdoches	M.A.	18s	30-36s	opt.			x
	Texas Christian University, Forth Worth	M.A., M.S.	30-36s	30-36s	(15)	x	x	
	Texas College of Arts and Industries, Kingsville	M.A.	18s	30s	req.			x
	Texas Southern University, Houston	M.A.	30s	30s	req.	x		x
	Texas Technological College, Lubbock	M.A., M.S.	24s	30-36s	opt.	x		x

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[13] Two languages (French, German, or Russian) are required.

[14] Also offered is a Master in Letters degree. From 16 to 20 credits are required in mathematics and 10 to 14 credits in one or two related fields. A thesis is not required for this degree.

[15] Thesis is required for the M.A. degree, optional for the M.S. degree.

APPENDIX A. MASTER'S PROGRAMS

In Mathematics: Institutions, program requirements, program characteristics, 1961--Continued

State	Institution and City	Degree(s) awarded	Credit requirement (inc. credit for thesis) s. semester; q. quarter		Thesis	Foreign language req.	Degree can be obtained by	
			In Math.	Total for the deg.			Eve. and/ or Sat. study	Summer study
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Texas	University of Houston, Houston...	M.A., M.S.	18s	30s	req.		x	x
	University of Texas, Austin......	M.A.	18s	30s	req.	x		x
Utah	Brigham Young University, Provo..	M.A.	(*)	(*)	req.			
	University of Utah, Salt Lake City..........................	M.A., M.S.	45q	45q	req.	x, M.A.		
	Utah State University, Logan.....	M.S.	39q	45q	req.			
Vt.	University of Vermont, Burlington.....................	M.A.	30s	30s	req.			
Va.	College of William and Mary, Williamsburg..................	M.A.	24s	24s plus thesis	req.	x		
	Madison College, Harrisonburg....	M.A.	24s	30s	req.		x	
	University of Richmond, Richmond.	M.A., M.S.	15s	27s	req.	x		
	University of Virginia, Charlottesville................	M.A.	24s	24s	req.	x		x
	Virginia Polytechnic Institute, Blacksburg.....................	M.S.	39q, Math. 30q, Stat.	45q	req.			x
	Virginia State College, Petersburg..........................	M.S.	21s	30s	req.	x		x
Wash.	Gonzaga University, Spokane......	M.S. in Appl.Math.	24s	30s	req.	x		
	University of Washington, Seattle	M.A., M.S.	36q	36q	(16)	x		x
	Washington State University, Pullman........................	M.A.	24s	30s	req.	x		
W. Va.	West Virginia University, Morgantown....................	M.A., M.S.	24-30s	30s	opt			x
Wis.	Marquette University, Milwaukee.....................	M.S.	24s	30s	opt.	(17)	x	x
	University of Wisconsin, Madison.......................	M.A.	24s	24s				
	University of Wisconsin, Milwaukee.....................	A.M., M.S.	18-24s	18-24s		(*)	x	x
Wyo.	University of Wyoming, Laramie..	M.A., M.S.	20s	30s	opt.			x

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[16] Expository thesis for M.A., research thesis for M.S. M.S. awarded without thesis to students who pass general examination for Ph.D.

[17] Foreign language requirement accompanies the thesis option.

APPENDIX A. MASTER'S PROGRAMS

Programs specially designed for teaching: Institutions, program requirements, program characteristics, 1961

Explanation and abbreviations:

M.-Master; A.-Arts; E., Ed., or Educ.-Education; S. or Science; N. or Nat.-Natural; req.-required; opt.-optional.
Absence of any entry in column 7 means that no provision is made for the writing of a thesis.
An "x" in column 8 means that a modern foreign language is required for the degree.
An "x" in column 9 means that it is possible to earn the degree through evening and/or Saturday study alone.
An "x" in column 10 means that it is possible to earn the degree through summer study alone.
An asterisk (*) means that information relative to that item was not supplied by the respondent.

State	Institution and City	Degree (s) awarded	Credit requirement (incl. thesis cr. if part of req.) s, semester; q, quarter			The-sis	For-eign lan-guage req.	Degree can be obtained by	
			In Math.	In educ-courses	Total for the deg.			Eve. and/ or Sat. study	Summer study
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Ala.	University of Alabama, University	M.A.	18s	0	30s	opt.			x
Alaska	University of Alaska, College	M.S. in Gen.Sci.	12s	0	30s	opt.			x
Ariz.	Arizona State College, Flagstaff	M.S. in Educ.	16s	6s	34s	opt.			x
	Arizona State University, Tempe	M.N.S.	12-21s	0	30s	opt.			
	University of Arizona, Tucson	M.A.	18s	(*)	30s				
Ark.	Arkansas State Teachers College, Conway	M.S.E.	15s	15s	30s	req.			x
Calif.	California State Polytechnic College, San Luis Obispo	M.A. in Educ.	18q	12q	45q				x
	Dominican College of San Rafael, San Rafael	M.T.S.	20-24s	0	30s			x	x
	Fresno State College, Fresno	M.A. with creden.	21s	22s	30s				
	Long Beach State College, Long Beach	M.A.	18s	As req. for cred.	30s	opt.			
	Los Angeles State College, Los Angeles	M.A.	24s	6s	30s	opt.		x	
	Sacramento State College, Sacramento	M.A.	20s	10s	30s	opt.			
	San Diego State College, San Diego	M.A.	18s	(*)	30s	opt.			
	San Jose State College, San Jose	M.A. (Teaching Obj.)	21s	(*)	30s	opt.			
	Stanford University, Stanford, Palo Alto	M.A. (Teaching Math.)	30-36q	12-15q	45q				x
Colo.	Colorado College, Colorado Springs	M.A.T.	22s	0	30s	req.			x
	Colorado State College, Greeley	M.A.	35q	30q[1]	45q	opt.			x
	Colorado State University, Fort Collins	M.A.T.	30q	0	45q				x
	University of Colorado, Boulder	M.Basic Science	24s	0	30s				x
Conn.	Central Connecticut State College, New Britain	M.S.	9-15s	9s	30s	req.		x	x
	University of Connecticut, Storrs	M.Ed.	12s	15s	27s	opt.		x	x
	Wesleyan University, Middletown	M.A.T.	15s	9s	30s	opt.			
	Yale University, New Haven	M.A.T.	28s	16s	36s		x		
Del.	University of Delaware, Newark	M. Ed. in Nat. Sci.	(*)	6s	30s	opt.		x	x
D.C.	American University	M.S.S.T.	6s	6s	30s			x	x
	Catholic University of America	M.T.S.	24s	(*)	30s				x
Fla.	Florida State University, Tallahassee	M.S.	18s	12s	36s	opt.			x
	University of Florida, Gainesville	M.S.	24s	6s	36s		x		x
	University of Miami, Coral Gables	M.A.	18s	0	30s				

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[1] 30 quarter hours at the undergraduate and graduate levels combined.

APPENDIX A. MASTER'S PROGRAMS

Programs specially designed for teaching: Institutions, program requirements, program characteristics, 1961--Continued

State	Institution and City	Degree (s) awarded	Credit requirement (incl. thesis or, if part of req.) s, semester; q, quarter			The-sis	For-eign lan-guage req.	Degree can be obtained by	
			In Math.	In educ. courses	Total for the deg.			Eve. and/ or Sat. study	Summer study
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Ga.	Emory University, Atlanta.......	M.A.T.	45q	15q	60q				x
	Georgia State College for Women, Milledgeville..........	M.Ed.	25q	20q	60q				x
Ida.	University of Idaho, Moscow........................	M.N.S.	10s	0	30s				x
Ill.	Eastern Illinois University Charleston....................	M.S. in Educ.	24-28q	12q	48q	opt.		x	x
	Illinois Institute of Technology, Chicago...............	M.S. for Teachers	36s	0	36s	req.		x	x
	Illinois State Normal University, Normal............	M.S. in Educ.	20s	9s	32s	req.[2]			x
	Northern Illinois University, De Kalb.......................	M.S. in Educ.	15s	0	32s	req.		x	x
	Northwestern University, Evanston......................	M.A., M.Ed.	30q. M.A.18q. M.Ed.	6q. M.A.18q. M.Ed.	36q			x	x x
	Southern Illinois University, Carbondale....................	M.S. in Educ.	30q	8-16q	48q				x
	University of Chicago, Chicago......................	M.A.T.	20-30q	18q	58q	req.			
	University of Illinois, Urbana.......................	M.S., M.Ed.	16s, M.S. 16s,M.Ed.	8s, M.S. 16s,M.Ed.	32s				x
	Western Illinois University Macomb.......................	M.S. in Educ.	36q	12q	48q				x
Ind.	Ball State Teachers College, Muncie...............	M.A. in Ed. M.S. in Ed.	32q	(*)	45q	opt.		x	x
	Indiana State Teachers College, Terre Haute..........	M.A.,M.S.	20s	12s	32s	opt.		x	x
	Indiana University, Bloomington...................	M.S.,M.A.T.	10-20s	20s	35s	opt.			x
	Purdue University, Lafayette.....................	M.S.	21s	(*)	33s				x
	University of Notre Dame, Notre Dame....................	M.S.	30s	0	30s	opt.			x
Iowa	Drake University, Des Moines....................	M.Sci. in Teaching	15s	15s	32s	req.		x	x
	Iowa State Teachers College, Cedar Falls..........	M.A. in Educ.	18s	7s	30-38s	opt.			x
	State University of Iowa, Iowa City.....................	M.S.	(*)	6s	30-38s	opt.			x
Kans.	Fort Hays Kansas State College, Hays................	M.S.	20s	10s	32s	opt.			x
	Kansas State College of Pittsburg, Pittsburg..........	M.S.	20s.	0	32s	opt.			x
	Kansas State Teachers College, Emporia..............	M.S.	20-25s	0	30-35s	opt.			x
	University of Kansas, Lawrence......................	M.S. in Ed.	10-15s	15s	30s	req.			x
La.	Louisiana Polytechnic Institute, Ruston............	M.Ed.	12s	18s	30s	opt.		x	x
	Louisiana State University, Baton Rouge...................	M.A., M.Ed.	21s,M.A. 12s, M.Ed.	9s,M.A. 18s M.Ed.	30s				
	Loyola University, New Orleans...................	M.S.	18s	(*)	30s	opt.			
	McNeese State College, Lake Charles..................	M.S. in Ed. M.Ed.	18s	12s	36s,M.S. 30s, M.Ed.	req. M.S.			x
	Northwestern State College, Natchitoches.........	M.S. in Ed.	24s	6s	30s	opt.			x
	Tulane University, New Orleans...................	M.A.T.	20s	10s	30s	opt.			x
Md.	Johns Hopkins University, Baltimore.....................	M.A.T.	12s	21s	30s				
	University of Maryland, College Park..................	M.A.	18s	18s	36s	req.			
Mass.	Boston College, Chestnut Hill..........................	M.A.T.	15s	15s	30s		x		
	College of Our Lady of the Elms, Chicopee................	M.E.	16s	10s	30s	req.	x	x	x

APPENDIX A. MASTER'S PROGRAMS

Programs specially designed for teaching: Institutions, program requirements, program characteristics, 1961--Continued

State	Institution and City	Degree (s) awarded	Credit requirement (incl. thesis cr. if part of req.) s, semester; q, quarter			The-sis	For-eign lan-guage req.	Degree can be obtained by	
			In Math.	In educ. courses	Total for the deg.			Eve. and/ or Sat. study	Summer study
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Harvard University, Cambridge	A.M.T.	12-15s	9-12s	30s				
	State College at Boston, Boston	M.Ed.	7s	28s	33s	req.			
	Suffolk University, Boston	A.M.T.	6s	18s	30s		x		
Mich.	Andrews University, Berrien Springs	M.A.T.	18-24s	6-12s	30s				
	Central Michigan University, Mount Pleasant	M.A.	10s	10s	30s	opt.		x	x
	Michigan State University, East Lansing	M.A.T.	33q	(*)	45q				x
	Northern Michigan College Marquette	M.A. in Teaching	18s	(*)	30s				x
	University of Detroit, Detroit	M.A.T.	24s	0	30s			x	x
	University of Michigan, Ann Arbor	M.A. for Sci. Teach.	20-24s	4s	30s	opt.			
	Wayne State University, Detroit	M.A.	20s	6s	32s			x	x
	Western Michigan University, Kalamazoo	M.A. in Sci.&Math.	20-24s	6-10s	30s	opt.		x	x
Minn.	Macalester College, St. Paul	M.Ed.	12s	10-13s	31s plus thesis	req.			x
	Mankato State College, Mankato	M.S.	27q	9q	45q	req.			x
	Moorhead State College Moorhead	M.S. in Educ.	9-27q	9q	45q	req.		x	x
	St. Cloud State College, St. Cloud	M.S.	15-21q	9-15q	45q	req.			x
	University of Minnesota, LSA College, Minneapolis	M.Ed.	24q	9-12q	45q	(3)		x	x
	University of Minnesota, Inst. Tech.Minneapolis	M.Ed.[4]	6q	36q	42q		x		
Miss.	Mississippi College, Clinton	M.Ed.	12-15s	(*)	24-30s	opt.			
	Mississippi Southern College, Hattiesburg	M.S.T.	30q	16q	46q	opt.			x
	Mississippi State University, State College	M.Ed.	24s	0	30s				x
	University of Mississippi, University	M.S. in Comb. Sci.	24s	0	36s	opt.			
Mo.	Central Missouri State College, Warrensburg	M.S. in Educ.	20s	12s	32s			x	x
	St. Louis University, St. Louis	M.A.(T), M.S.(T)	(*)	Not spec.	30s	(5)	x		x
	Southwest Missouri State College, Springfield	M.Ed., M.S.T.	32s, M,S,T. 16s, M.Ed.	0,M,S,T 16s, M.Ed.	32s				x,M.Ed.
	University of Missouri, Columbia	M.S.T.	varies	(*)	32s				x
	Washington University, St. Louis	M.A. in Educ.	12-24s	9-21s	33s				
Mont.	Montana State University, Missoula	M.A.T., M.S.T.	28-35q	(*)	45-60q	(6)			x
Nebr.	State Teachers College, Kearney	M.A. in Educ.	15s	9s	36s	opt.			x
	State Teachers College, Wayne	M.S. in Educ.	18s	4s	(*)	opt.			x
Nev.	University of Nevada, Reno	M.A. in Sec. Ed.	15s	15s	30s	req.			x
N.H.	University of New Hampshire, Durham	M.S.T.	30s	0	30s			x	x
N.J.	Montclair State College, Upper Montclair	M.A.	18s	6s	32s	opt.		x	x
	Rutgers, The State University, New Brunswick	M.A.	24s	6s	30s	opt.		x	

APPENDIX A. MASTER'S PROGRAMS

Programs specially designed for teaching: Institutions, program requirements, program characteristics, 1961--Continued

State	Institution and City	Degree (s) awarded	Credit requirement (incl. thesis cr. if part of req.) s, semester; q, quarter			Thesis	Foreign language req.	Degree can be obtained by	
			In Math.	In educ. courses	Total for the deg.			Eve. and/ or Sat. study	Summer study
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
N.M.	New Mexico Highlands University, Las Vegas..........	M.A. in Sci. Ed.	12q	Not spec.	48q	opt.			
	University of New Mexico, Albuquerque....................	M.Ed. in Science	18s	10s	34s			x	x
N.Y.	Adelphi College, Garden City....	M.S.	24s	(*)	36s	opt.		x	
	Brooklyn College, Brooklyn......	M.A.	15s	8-14s	30s	req.		x	
	Clarkson College of Technology, Potsdam.........................	M.S. in Basic Sci.	20s	0	30s				
	Colgate University, Hamilton.......................	M.A.T.[7]	24s	6s	30s	req.			x
	Columbia University, New York.......................	M.A. in Educ.	18s	14s	32s	opt.		x	x
	Cornell University, Ithaca.........................	M.A.T.	Not spec.	Not spec.	Not spec.				
	Fordham University, New York.......................	M.S.	30s	6s	36s			x	x
	Hobart and William Smith Colleges, Geneva..............	M.S. in Educ.	15s	15s	30s	req.	x	x	x
	Hofstra College, Hempstead, Long Island..................	M.A. in Nat. Sci.	21s	9s	33s	opt.	x	x	
	Hunter College, New York	M.A.	21s	6s	30s			x	
	New York University, New York.......................	M.A. in Educ.	0	24s	30s plus thesis	req.		x	x
	St. John's University, Jamaica.........................	M.A. in Educ.	12-18s	15-21s	33s			x	x
	State University of New York, College of Education at Albany...........	M.A.,M.S.	18s	6s	30s	opt.			x
	College of Education at Brockport.....................	M.S. in Educ.	9-12s	12s	32s	opt.		x	x
	College of Education at Cortland.......................	M.S.	12s	9s	32s				x
	College of Education at Geneseo........................	M.S.	10s	9s	32s				x
	College of Education at Oneonta........................	M.S.	12s	9-12s	32s	opt.			x
	College of Education at Oswego.........................	M.S.	12s	6s	30s				x
	College of Education at Plattsburgh...................	M.S. in Educ.	12s	18-24s	33s	opt.			x
	College of Education at Potsdam........................	M.S. In Educ.	15s	3s	32s			x	x
	Syracuse University, Syracuse.......................	M.Ed.	18s	12s	30s	opt.			x
	Union College and University, Schenectady.............	M.S. in Teaching	20s	(*)	30s			x	x
N.C.	Appalachian State Teachers College, Boone................	M.A.	18q	21q	39-54q	opt.			x
	Duke University, Durham.........................	M.A. in Teaching	18-24s	6-12s	30s[8]	opt.			x
	East Carolina College, Greenville....................	M.A.	27q	3q	45q	req.		x	x
	University of North Carolina, Chapel Hill.........	M.Ed.	18s	6s	30s	opt.			x
	Western Carolina College, Cullowhee.....................	M.A. in Educ.	18q	27q	45q	opt.			x
N.D.	North Dakota State University Fargo..............	M.Ed.	15q	(*)	45q	opt.		x	x
Ohio	Bowling Green State Unisity, Bowling Green...........	M.A.	15s	(*)	33s				x
	John Carroll University, Cleveland.....................	M.A.	9s	21s	30s	opt.	(9)	x	x
	Kent State University, Kent..........................	M.Ed.	27q	15q	48q				x
	Miami University, Oxford........................	M.A.T. M.Ed.	15s	9s,M.Ed. 0-6s,M.A.T.	36s				x
	Ohio State University, Columbus.....................	M.A., M.Ed.	15q	15q	45q.,M.A. 52q.,M.Ed.	(10)			x
	University of Akron, Akron.........................	M.Ed.	12s	(*)	(*)	req.		x	

APPENDIX A. MASTER'S PROGRAMS

Programs specially designed for teaching: Institutions, program requirements, program characteristics, 1961--Continued

State	Institution and City	Degree (s) awarded	Credit requirement (incl. thesis cr. if part of req.) s, semester; q, quarter			Thesis	Foreign language req.	Degree can be obtained by	
			In Math.	In educ. courses	Total for the deg.			Eve. and/or Sat. study	Summer study
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Ohio	University of Dayton, Dayton	(*)	12-18s	9s	30s			x	x
	Western Reserve University, Cleveland	M.A.,M.S.	9s	(*)	30s				x
	Xavier University, Cincinnati	M.Ed.	12s	12s	30s			x	x
	Central State College, Edmond	M. of Teaching	up to 30s	2s and up	32s			x	x
	Northwestern State College, Alva	M. of Teaching	8-16s	8-16s	32s				x
	Southeastern State College Durant	M. of Teaching	8-12s	12s	32s			x	x
	Southwestern State College, Weatherford	M. of Teaching	9s	8s	32s				x
Ore.	Oregon State University, Corvallis	M.S., M.A., M.Ed.	(*)	(*)	45q				
	Reed College, Portland	M.A.T.	10-15s	5-10s	30s	req.		x	x
	Southern Oregon College Ashland	M.S. in Educ.	up to 21q	21q	45q				
	University of Oregon, Eugene	M.A.,M.S.	30q	9q	45q		x,M.A.		
Pa.	Bucknell University, Lewisburg	M.S. in Educ.	18s	0	30s				x
	Indiana State College, Indiana	M.S. in Educ.	14-22s	8-10s	30s	opt.		x	x
	Pennsylvania State University, University Park	M.Ed.	18s	6s	30s	opt.			
	Temple University, Philadelphia	(*)	(*)	(*)	(*)			x	
	Villanova University, Villanova	M.Sec. Sch. Sci.	12s	12s	30s				
	West Chester State College, West Chester	M.Ed.	18-24s	2s	30s	req.			
R.I.	Brown University, Providence	M.A.T.	4 math-courses	4-5 ed. courses	32s	req.			
S.C.	Clemson College, Clemson	M.Ed.	6-9s	12s	30s				x
	South Carolina State College, Orangeburg	M.S., M.Ed.	15s,M.S. 21s, M.Ed	15s	30s,M.S. 36s,M.Ed.	(*)			
	University of South Carolina, Columbia	M. of Math.	24s	6s	30s				x
S.D.	Northern State Teachers College, Aberdeen	M.S. in Educ.	12-18q	18q	45q	opt.			x
	State University of South Dakota, Vermillion	M.Ed.	15-17s	18-20s	35s				x
Tenn.	East Tennessee State College, Johnson City	M.A.	15-21q	24-30q	45q	req.		x	x
	George Peabody College for Teachers, Nashville	M.A.	24-36q	16[12]	48q	opt.			x
	Middle Tennessee State College, Murfreesboro	M.A.	15s	10s	32s	opt.		x	x
	Vanderbilt University, Nashville	M.A.T.	18s	18s max.	36s	opt.	x		
Texas	East Texas State College, Commerce	M.Ed.	24s	12s	36s	opt.			
	Hardin-Simmons University, Abilene	M.Ed.	12s	18s	30s	opt.			x
	Incarnate Word College, San Antonio	M.A.,M.Ed.	12-18s	18s	30-36s	(13)	x,M.A.	x	x
	North Texas State College, Denton	M.Ed.	18s	18s	36s	opt.			x
	Prairie View Agric. and Mech. College, Prairie View	M.S.	18s	9s	30s	req.		x	x
	St. Mary's University, San Antonio	M.A.	36s	0	36s	opt.		x	
	Sam Houston State Teachers College, Huntsville	M.Ed., M.A.	18s	(*)	30s,M.A. 36s,M.Ed.	req. M.A.	x, M.A.		x
	Stephen F. Austin State College, Nacogdoches	M.A.	18s	12s	30-36s	opt.			x

APPENDIX A. MASTER'S PROGRAMS

Programs specially designed for teaching: Institutions, program requirements, program characteristics, 1961--Continued

State	Institution and City	Degree (s) awarded	Credit requirement (incl. thesis cr. if part of req.) s, semester; q, quarter			The-sis	For-eign lan-guage req.	Degree can be obtained by	
			In Math.	In educ. courses	Total for the deg.			Eve. and/ or Sat. study	Summer study
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Texas Christian University, Fort Worth....................	M.S. in T. of Math.	18s	12s	30s	req.			x
	Texas Southern University, Houston......................	M.Ed.	18s	18s	36s	req.			x
	Texas Technological College, Lubbock.............	M.S. in Educ.	18-24s	12-18s	36s	opt.	(14)		x
	West Texas State College, Canyon........................	M.Ed.	24s	12s	36s	opt.	x	x	x
Vt.	University of Vermont, Burlington....................	M.A.T.	24s	6s	30s				
Va.	Madison College, Harrisonburg..................	M.S.	18-21s	9s	30s	opt.			x
	University of Virginia Charlottesville...............	M.A.T., M.Ed.	12s,M. A.T.15s M.Ed.	12s,M. A.T.9s, M.Ed.	30s	opt., M.Ed.			x
Wash.	Gonzaga University, Spokane.......................	M.S. of Ed. in Nat. Sci.	18s	6s	30s	req.	x	x	x
	Seattle University, Seattle.......................	M.S. in Nat. Sci.	30q	0	45q	opt.			x
	University of Washington, Seattle.......................	M.A.	39q	(*)	(*)	req.			
	Washington State University, Pullman.......................	M.A.T.	26s	0	32s				x
	Western Washington College of Education, Bellingham....................	M.Ed., M.T. of Math.	33-36q	12q	45q	opt.			x
W. Va.	West Virginia University, Morgantown.....................	M.S.	24-30s	0	30s	opt.			x
Wis.	University of Wisconsin, Madison.......................	M.A.	12s	12s	24s	opt.			x
	University of Wisconsin, Milwaukee....................	M.S. in Math.-Ed.	12s	12s	24s	(*)	(*)	x	x
Wyo.	University of Wyoming, Laramie.......................	M.S. in Nat. Sci.	10s	0	30s				x

APPENDIX A. MASTER'S PROGRAMS: Institutions with master's programs in statistics, 1961

State	Institution	State	Institution
Alabama	University of Alabama, University	New Jersey	Rutgers, The State University, New Brunswick
California	Stanford University, Stanford University of California at Berkeley University of California at Los Angeles	New York	Columbia University, New York Cornell University, Ithaca New York University, New York University of Rochester, Rochester
Colorado	University of Denver, Denver		
Delaware	University of Delaware, Newark	North Carolina	University of North Carolina, Chapel Hill University of North Carolina, State College, Raleigh
District of Columbia	American University George Washington University	Ohio	Western Reserve University, Cleveland
Illinois	University of Chicago, Chicago University of Illinois, Urbana	Pennsylvania	University of Pennsylvania, Philadelphia Villanova University, Villanova
Iowa	Iowa State University, Ames State University of Iowa, Iowa City	Tennessee	University of Tennessee, Knoxville
Kansas	Kansas State University, Manhattan	Texas	Southern Methodist University, Dallas University of Texas, Austin
Louisiana	Tulane University, New Orleans		
Massachusetts	Harvard University, Cambridge	Virginia	Virginia Polytechnic Institute, Blacksburg
Michigan	Michigan State University, East Lansing University of Michigan, Ann Arbor	Washington	University of Washington, Seattle
Minnesota	University of Minnesota, Minneapolis	Wisconsin	University of Wisconsin, Madison
Missouri	University of Missouri, Columbia	Wyoming	University of Wyoming, Laramie

APPENDIX B. DOCTOR'S PROGRAMS

In Mathematics: Institutions, credit requirements, areas of specialization, and number of degrees, January 1958 to January 1961, inclusive

Explanation of abbreviations and symbols:

"Not spec." means that there are no specific credit requirements.

"New prog." indicates that the program has been recently established and no degrees had yet been conferred.

State	Institution and City	Credit requirement beyond bachelor's, incl. cred. for thesis except as noted (s-semester; q-quarter, Data in parentheses are approx.)		Total number of deg. Jan. '58 to Jan. '61 inclusive	No. of deg. in area of specialization, Jan. '58-Jan. '61, incl. (x denotes specialization offered, no deg. was given)							
		In math.	Total for the degree		Algebra	Analysis	Applied Math	Geometry	Logic	Statistics	Topology	Other
Ala.	Auburn University, Auburn	Not spec.	Not spec.	8	2	3	2	x		1	x	
	University of Alabama, University	48s	54s plus thesis	New prog.		x					x	
Ariz.	University of Arizona, Tucson	60s	75s	New prog.	x	x	x			x		
Calif.	California Institute of Technology, Pasadena	Not spec.	Not spec.	10	4	6	x				x	
	Stanford University, Stanford	75q	75q plus thesis	28	1	8	2		x	16	1	
	University of California at Berkeley	Not spec.	Not spec.	42	3	13	6	3	x	15	1	Probability 1
	University of California at Davis	Not spec.	Not spec.	New prog.	x	x		x		x	x	
	University of California at Los Angeles	Not spec.	Not spec.	30	4	11	5		2	5	1	Number Theory 2
	University of Southern California, Los Angeles	60s	60s plus thesis	4	1	3		x			x	
Colo.	Colorado State University, Fort Collins	60q	90q plus thesis	New prog.						x		
	University of Colorado, Boulder	([a])	([b])	8	5	3	x					
Conn.	Yale University, New Haven	(50s)	(50s) plus thesis	20	x	16		2	1	x	1	
Del.	University of Delaware, Newark	Not spec.	Not spec.	New Prog.			x			x		
D.C.	American University	(50s)	72s	4	x	1				3		
	Catholic University	36s	54s plus thesis	9	3	3		1		1		Numer. Anal. 1
	George Washington University	Not spec.	Not spec.	7	x	1		x	x	6		
	Georgetown University	48s	48s	New prog.		x						
Fla.	Florida State University, Tallahassee	60s	60s plus thesis	New prog.	x	x					x	
	University of Florida, Gainesville	(80s)	(80s)	11[c]	3		3	2			1	
Ga.	University of Georgia, Athens	Not spec.	Not spec.	2		x					2	
Idaho	University of Idaho, Moscow	45s 45s	60s plus thesis	New prog.			x			x		
Ill.	Illinois Institute of Technology, Chicago	96s	96s	7	2	2	2	1	x			
	Northwestern University, Evanston	108q	108q	5	x	5				x	x	
	University of Chicago, Chicago	Not spec.	Not spec.	22	5	6		1	1	4	5	
	University of Illinois, Urbana	60s	72s	43	5	29	4	x	x	5	x	
Ind.	Indiana University, Bloomington	75-80s	90s	7	1	x	1	1		1	1	Probability 2
	Purdue University, Lafayette	36s	48s plus thesis	27	2	9	1			10	5	
	University of Notre Dame, Notre Dame	Not spec.	Not spec.	1	x	x	x		1		x	
Iowa	Iowa State University, Ames	80q[d]	100q[d]	22	3	6	3			8		Stat. Econ. 1 Ag. Eng. Math. 1
	State University of Iowa, Iowa City	Not spec.	90s	6	x	x		x		4	x	Alg. Geom. 2
Kans.	University of Kansas, Lawrence	Not spec.	Not spec.	7	3	3				x	1	
Ky.	University of Kentucky, Lexington	60-72s	72s	6	x	6					x	
La.	Louisiana State University, Baton Rouge	(60s)	Not spec.	5	1	1					1	Topological Alg. 2
	Tulane University, New Orleans	48s	48s plus thesis	5	3	x					1	Number Theory 1

[a] In algebra and analysis, 30 sem. hrs. in courses numbered above 500; in applied math., 33 sem. hrs.

[b] In algebra and analysis, 30 sem. hrs. in courses numbered above 500; in applied math., 48 sem. hrs.

[c] University of Florida granted 2 degrees in analysis during the period, but is not currently offering this specialization.

[d] Unofficial requirements.

APPENDIX B. DOCTOR'S PROGRAMS

In Mathematics: Institutions, credit requirements, areas of specialization, and number of degrees, January 1958 to January 1961, inclusive--Continued

State	Institution and City	Credit requirement beyond bachelor's, incl. cred. for thesis except as noted (s-semester; q-quarter, Data in parentheses are approx.)		Total number of deg. Jan. '58 to Jan. '61 inclusive	No. of deg. in area of specialization, Jan. '58-Jan. '61, incl. (x denotes specialization offered, no deg. was given)							
		In math.	Total for the degree		Algegra	Analysis	Applied math	Geometry	Logic	Statistics	Topology	Other
Md.	Johns Hopkins University, Baltimore........................	Not spec.	Not spec.	3	1	2	x	x			x	Number Theory x
	University of Maryland, College Park............................	Not spec.	Not spec.	12	x	2	10	x	x	x	x	
Mass.	Boston University, Boston..........	68s	78s	8	1	2	2			3		
	Brandeis University, Waltham.......	36s	36s	New prog.	x	x		x			x	
	Harvard University (incl. Radcliffe College) Cambridge...............	Not spec.	Not spec.	23	4	10	x	4	2	2	1	
	Massachusetts Institute of Technology, Cambridge............	(36s)	(57s) plus thesis	21	2	7	6	2	2		1	Probability 1
Mich.	Michigan State University, East Lansing..........................	120-145q[e]	120-145q[f]	10	1	3	2	x		4	x	Number Theory x
	University of Michigan, Ann Arbor..	Not spec.	Not spec.	26	2	5	4	1	1	3	6	(g)
	Wayne State University, Detroit....	90s	90s	6	x.	4	x			1	1	
Minn.	University of Minnesota, Minneapolis......................	45q	67 1/2 q plus thesis	16	2	14						
Mo.	University of Missouri, Columbia...	Not spec.	Not spec.	4	x	2		1			1	
	St. Louis University, St. Louis....	Not spec.	(60s) plus thesis	9	x	2		x		4	1	Number Theory 2
	Washington University, St. Louis...	72s	72s plus thesis	2	1	1						
Mont.	Montana State College, Bozeman.....	72q	72q plus thesis	New prog.	x		x			x	x	
Neb.	University of Nebraska, Lincoln....	74-90s	90s	2	x	1			1	x	x	Number Theory x
N.J.	Princeton University, Princeton....	Not spec.	Not spec.	31	3	8	3	x	5	3	8	Mathematical Physics 1
	Rutgers, The State University, New Brunswick.......................	81s	90s[h]	4	2	2				x	x	
	Stevens Institute of Technology, Hoboken..........................	40s	90s	0		x	x					
N. Mex.	New Mexico State University, University Park..................	Not spec.	Not spec.	New prog.	x	x					x	
	University of New Mexico, Albuquerque.....................	48s	60s plus thesis	New prog.	x	x	x			x	x	
N.Y.	Adelphi College, Garden City.......	54s	54s	New prog.	x	x	x					
	Columbia University, New York......	60s[i]	60s plus thesis	18	3	3	2	x	x	7	3	
	Cornell University, Ithaca.........	Not spec.	Not spec.	9	1	5		x	1	1	1	
	New York University, New York......	42s	72s plus thesis	54	5	19	23	2		3	2	
	Polytechnic Institute of Brooklyn, Brooklyn........................	(64s)	(79s)	New prog.	x	x	x					
	Rensselaer Polytechnic Institute, Troy............................	45-60s	60s plus thesis	3			3					
	Syracuse University, Syracuse......	Not spec.	90s	4	x	2	x			x	2	
	University of Buffalo, Buffalo.....	64s	90s plus thesis	3	1	1				1		
	University of Rochester, Rochester.	64s	64s plus thesis	3		3						
	Yeshiva University, New York.......	(90s)	90s	New prog.		x		x	x			
N.C.	Duke University, Durham............	48s	60s	7	2	1	x		x		4	
	University of North Carolina (Chapel Hill)...................	Not spec.	Not spec.	17	2	1	1	x		11	2	
	University of North Carolina (Raleigh).......................	(45s)	55s plus thesis	15			x			15		
Ohio	Case Institute of Technology, Cleveland.......................	42s	60s plus thesis	5	1	x	3		x	x	1	

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[e] Ninety quarter hours in mathematics and statistics are required for specialization statistics.

[f] One hundred thirty-five quarter hours are required for statistics.

[g] The University of Michigan also offers the following specializations: Functional analysis, number theory, actuarial science, and the history of mathematics. Four doctoral degrees in functional analysis were conferred during the period covered by this study.

[h] For specialization in statistics 15 semestér hrs. in mathematics and 75 semester hrs. in statistics are required.

[i] This specialization was first authorized in 1959.

Thirty-five semester hrs. are required for specialization in statistics.

APPENDIX B. DOCTOR'S PROGRAMS

In Mathematics: Institutions, credit requirements, areas of specialization, and number of degrees, January 1958 to January 1961, inclusive--Continued

State	Institution and City	Credit requirement beyond bachelor's, incl. cred. for thesis except as noted (s-semester; q-quarter, Data in parentheses are approx.)		Total number of deg. Jan. '58 to Jan. '61 inclusive	No. of deg. in area of specialization, Jan. '58-Jan. '61, incl. (x denotes specialization offered, no deg. was given)							
		In Math.	Total for the degree		Algebra	Analysis	Applied Math	Geometry	Logic	Statistics	Topology	Other
Ohio	Ohio State University, Columbus....	Not spec.	135q	10	3	3	1		1	1	1	
	University of Cincinnati, Cincinnati........................	Not spec.	Not spec.	6	1	5	x		x			
	Western Reserve University, Cleveland........................	Not spec.	Not spec.	New prog.	x	x		x			x	
Okla.	Oklahoma State University, Stillwater........................	90s	90s	9		3				3		
	University of Oklahoma, Norman.....	90s	90s	2		x		x			2	
Ore.	Oregon State University, Corvallis........................	80q	(135q)	5	x	3	1	x			1	Comp. Sci. & Tech. x
	University of Oregon, Eugene.......	126q	135q	6		3				1	x	Number Theory 2
Pa.	Bryn Mawr College, Bryn Mawr.......	6 courses	8 courses	0		x					x	
	Carnegie Institute of Technology, Pittsburgh........................	96s	96s	10	1	4	3			2		
	Lehigh University, Bethlehem.......	(60s)	(60s) plus thesis	4	x	3		1	x		x	
	Pennsylvania State University, University Park..................	60s[k]	90s[k]	1		1			x			
	University of Pennsylvania, Philadelphia.....................	54s	54s	16	4	6					4	Number Theory 2
	University of Pittsburgh, Pittsburgh.......................	Not spec.	Not spec.	15	1	4	3	1			6	
R.I.	Brown University, Providence.......	Not spec.	Not spec.	24	1	2	17				2	Math. Econ. 2
S.C.	University of South Carolina, Columbia.........................	Not spec.	Not spec.	New prog.	x	x					x	
Tenn.	University of Tennessee, Knoxville.	Not spec.	Not spec.	13	3	4		1			5	
	Vanderbilt University, Nashville...	54s	72s plus thesis	2	x	x		x			1	Lattice Theory 1
Texas	Agricultural and Mechanical College of Texas, College Station........	Not spec.	96s	1								Differential Equa. 1
	Rice University, Houston...........	8 Advanced Courses	8 advanced Courses	5	1	4	x					
	University of Texas, Austin........	Not spec.	Not spec.	14	x	7	1			x	3	Differential Equa. 3
Utah	University of Utah, Salt Lake City.	Not spec.	Not spec.	1							1	
Va.	University of Virginia, Charlottesville..................	Not spec.	Not spec.	7	x	1					6	
	Virginia Polytechnic Institute, Blacksburg.......................	105q[l]	135q	16	x	x	x	x		16	x	
Wash.	University of Washington, Seattle..	Not spec.	Not spec.	17	4	7		2		1	3	
	Washington State University, Pullman..........................	Not spec.	Not spec.	1	x	1	x	x		x	x	
Wis.	University of Wisconsin, Madison...	Not spec.	Not spec.	18	6	6		2			4	

[j] Thirty-nine semester hrs. in mathematics and statistics are required for specialization in statistics.
[k] Pennsylvania State University went into a modified quarter system in June 1961.
[l] Sixty quarter hrs. of mathematics and statistics are required for specialization in statistics.

APPENDIX B. DOCTOR'S PROGRAMS

Programs specially designed for teaching: Institutions, kinds of degrees awarded, credit and foreign language requirements, and numbers of degrees from January 1958 to January 1961, inclusive

Explanation of abbreviations and symbols:

Ph. D.-Doctor of Philosophy; Ed. D.-Doctor of Education

"Not spec." means that there are no specific credit requirements.

"New Prog." indicates that the program has been recently established and no degrees had yet been conferred.

An asterisk "*" means that information relative to that item was not supplied by the respondent.

State	Institution and city	Degree (s) awarded	Credit requirement beyond baccalaureate (s denotes semester; q, quarter)			Number of foreign languages required	No. of degrees granted Jan. '58 to Jan. '61
			In math.	In education courses	Total for the degree		
Calif.	Stanford University, Stanford.	Ph. D., Ed. D.	(*)	(*)	(*)	(*)	New Prog.
Fla.	Florida State University, Tallahassee.................	Ph. D., Ed. D. Ph. D., Ed. D.	30s 30s	20s 20s	60s 60s	2 for[a] Ph. D.	1
	University of Florida Gainesville.................	Ed. D.	27-42s	27-42s	Approx. 84s	None	1
Ill.	Northwestern University, Evanston....................	Ed. D., Ph. D.	36q	54q	108q	1 for Ph. D.	0
	University of Illinois, Urbana......................	Ph. D., Ed. D.	24s	48s	96s	2 for Ph. D.	3
Ind.	Indiana University, Bloomington.................	Ed. D., Ph. D.	30s	30s	90s	2 for Ph. D.	1
	Purdue University, Lafayette..	Ph. D.	48s	21s	96s plus thesis	2[b]	0
Iowa	State University of Iowa, Iowa City........................	Ph. D.	Not spec.	Not spec.	90s	2	1
Kans.	University of Kansas, Lawrence	Ph. D.	35s	35s	90s	2	0
La.	Louisiana State University, Baton Rouge.................	Ph. D., Ed. D.	36s	36s Ph. D. 48s Ed. D.	72s	2	New Prog.
Mass.	Harvard University, Cambridge.	Ed. D. in Math. Educ.	(*)	(*)	(*)	(*)	New Prog.
Mich.	University of Michigan, Ann Arbor......................	Ed. D. in Math., Ph. D.	28s, Ed. D. 50s, Ph. D.	37s, Ed. D. 12s, Ph. D.	65s	2	1 Ph. D. 1 Ed. D.
Mo.	Washington University, St. Louis......................	Ed. D., Ph. D.	Not spec.	Not spec.	76s, Ed. D. 72s, Ph. D.	1 for Ed. D. 2 for Ph. D.	0
N.Y.	Columbia University, New York.	Ed. D., Ph. D.	30s, Ed. D. 40s, Ph. D.	37s	90s, Ed. D. 75s, Ph. D.	2 for Ph. D.	4 Ph. D. 14 Ed. D.
	New York University, New York.	Ed. D., Ph. D.	Not spec.	Not spec.	79s, Ed. D. 67s, Ph. D.	2 for Ph. D.	12 Ph. D. 3 Ed. D.
	Syracuse University, Syracuse.	Ph. D.	33s	12s	90s	2[c]	0
	Yeshiva University,[d] New York.	Ph. D.	54s	9s	90s	2	New Prog.
Ohio	Ohio State University, Columbus....................	Ph. D.	M.A. in Math. or 20q	60q	135q	1[e]	5
Okla.	Oklahoma State University, Stilwater...................	Ed. D.	60s	30s	Not spec.	None	4
Pa.	Pennsylvania State University, University Park.............	D. Ed.	45s	15s	90s	None	New Prog.
Tenn.	George Peabody College for Teachers, Nashville.........	Ph. D.	72q	16q[f]	108q	2	2
Texas	North Texas State College, Denton......................	Ed. D.	Not spec.	36s	90s	([g])	0
	University of Texas, Austin...	Ph. D., Ed. D.	Not spec.	Not spec.	Not spec.	2	5
Va.	University of Virginia, Charlottesville.............	Ed. D.	30s	42s plus thesis	72s plus thesis	2	2
Wis.	University of Wisconsin, Madison....................	Ph. D.	Not spec.	Not spec.	Not spec.	2	3

[a] For Ed. D. proficiency in statistics is substituted.

[b] Or one language and statistics.

[c] Use of computer, statistics may be used as substitutions.

[d] This is a doctoral program for college teachers of mathematics.

[e] Substitutions permitted in special cases.

[f] Not required if student enters with sufficient background in professional education.

[g] A foreign language requirement is included only if considered needed for thesis.

Note: University of Maryland reported that a doctoral program specially designed for teaching of mathematics is in the process of being established.

APPENDIX B.
DOCTOR'S PROGRAMS

Institutions at which doctor's degrees in mathematics may be earned through evening and/or Saturday study, or through summer study.

EVENING AND/OR SATURDAY

Adelphi College, Garden City, N.Y.
American University, Washington, D.C.
University of Buffalo, Buffalo, N.Y.
Georgetown University, Washington, D.C.
George Washington University, Washington, D.C.
Illinois Institute of Technology, Chicago, Ill.
New York University, New York, N.Y.
University of Pittsburgh, Pittsburgh, Pa.
Yeshiva University, New York, N.Y.

SUMMER STUDY

Michigan State University of Agriculture and Applied Science, East Lansing, Mich. (Statistics only)
Montana State College, Bozeman, Mont.
University of North Carolina, Chapel Hill, N.C.
University of Pittsburgh, Pittsburgh, Pa.

Institutions at which doctor's degrees specially designed for the teaching of mathematics may be earned through evening and/or Saturday study, or through summer study.

EVENING AND/OR SATURDAY STUDY

New York University, New York, N.Y.

SUMMER STUDY

New York University, N.Y.
Pennsylvania State University, University Park, Pa.
University of Texas, Austin, Tex.

APPENDIX C. COMPUTERS

Institutions with digital computers on campus in 1961;
make and model number of each computer, and
year of installation, if known

Alabama		
	Auburn University, Auburn	IBM 650, (1959)
	University of Alabama, University	Remington Rand Solid State 80, (1961)
Arizona		
	Arizona State University, Tempe	G. E. 304, (1960)
	University of Arizona, Tucson	IBM 650, (1957)
Arkansas		
	University of Arkansas, Fayetteville	IBM 650, (1960)
California		
	California Institute of Technology, Pasadena	Burroughs 220
	California State Polytechnic College, San Luis Obispo	Bendix G-15, (1960)
	Chico State College, Chico	IBM 1620 (to be available 1961-1962)
	Claremont Men's College, Claremont	Bendix G-15, (1960)
	Harvey Mudd College, Claremont	IBM 1620 (expected by Sept. 1961)
	Los Angeles State College, Los Angeles	IBM 650, (1961)
	Pomona College, Claremont	Bendix G-15, (1958)
	Sacramento State College, Sacramento	LGP-30, (1961)
	San Diego State College, San Diego	IBM 650, (1960)
	San Jose State College, San Jose	IBM 650
	Stanford University, Stanford, Palo Alto	IBM 650, (1957); Burroughs 220, (1960)
	University of California at Davis	IBM 1620, (1961)
	University of California at Berkeley (does not include computers in use by Lawrence Radiation Laboratory and other AEC projects)	IBM 701, (1956); Bendix G-15, (1959); IBM 704, (1959); IBM 1620, (1961); IBM 1620 on order
	University of California at Los Angeles	SWAC (at least 10 years old); IBM (7090, (1961); IBM 1401, (1961); IBM 1401, expected in January 1962. Variable Logic Computer under construction.
	University of California at Riverside	IBM 1620
	University of Southern California, Los Angeles	Remington Rand Solid State 80, (1961); Minneapolis Honeywell 800, (1961)
Colorado		
	Colorado State University, Fort Collins	IBM 1620, (1961)
	University of Colorado, Boulder	Bendix Digital Computer, part no. G-15-D serial no. 155, (1958)
	University of Denver, Denver	Burroughs 205, (1955)
Connecticut		
	Wesleyan University, Middletown	LGP-30, (1960)
	Yale University, New Haven	IBM 650; IBM 7070 on order
Delaware		
	University of Delaware, Newark	Bendix G-15, (1958)
District of Columbia		
	American University	3 Royal McBee CPC computers
	George Washington University	The Logistics Computer, (1953); Abe (1951)
	Georgetown University	2 Burroughs E-101
Florida		
	Florida State University, Tallahassee	IBM 650
	University of Florida, Gainesville	IBM 650
Georgia		
	Georgia Institute of Technology, Atlanta	UNIVAC 1101; Burroughs 220; IBM 650
	Georgia State College of Business Administration, Atlanta	IBM 305 RAMAC
	University of Georgia, Athens	IBM 650, (1960)
Hawaii		
	University of Hawaii, Honolulu	IBM 650, (1959)

Appendix C.--Continued

Illinois		
	Illinois Institute of Technology, Chicago	IBM 650
	Northwestern University, Evanston	IBM 650, (1958)
	Southern Illinois University, Carbondale	IBM 650, (1959)
	University of Illinois, Urbana	ILLIAC; IBM 650
	University of Chicago, Chicago	UNIVAC I; MANIAC III; 2 IBM's 1620; LGP-30
Indiana		
	Indiana University, Bloomington	IBM 650, (1956); IBM 709 System and Auxiliary Tape Equipment on order
	Purdue University, Lafayette	Burroughs 205; Remington Rand Type 80
	Rose Polytechnic Institute, Terre Haute	Bendix G-15D, Alphanumeric, (1960)
	University of Notre Dame, Notre Dame	IBM 610
	Valparaiso University, Valparaiso	IBM 610
Iowa		
	Iowa State University, Ames	IBM 650, (1957); CYCLONE, (1959)
	State University of Iowa, Iowa City	IBM 7070, (1961)
Kansas		
	Kansas State University, Manhattan	IBM 650, (1958)
	University of Kansas, Lawrence	IBM 650; IBM 1620 on order
	University of Wichita, Wichita	IBM 610, (1959)
Kentucky		
	University of Kentucky, Lexington	IBM 650
	University of Louisville, Louisville	IBM 1620, (1960)
Louisiana		
	Louisiana Polytechnic Institute, Ruston	LGP-30
	Louisiana State University, Baton Rouge	IBM 650
	Tulane University, New Orleans	IBM 650, (1958)
Maryland		
	University of Maryland, College Park	IBM 1620; LGP-30; IBM 1401 on order
Massachusetts		
	Boston University, Boston	IBM 650
	Harvard University, Cambridge	UNIVAC I; IBM 650
	Lowell Technological Institute, Lowell	RPC-4,000 Computer on order
	Massachusetts Institute of Technology, Cambridge (does not include computers in use at the Lincoln and Mitre Laboratories)	IBM 704; 2 IBM 650; 4 LPG-30; Bendix G-15; TX-0
	Northeastern University, Boston	IBM 650, (1959)
	University of Massachusetts, Amherst	IBM 1620 to be installed in 1962
	Worcester Polytechnic Institute, Worcester	IBM 610, (1959)
Michigan		
	General Motors Institute, Flint	IBM 1620
	Lawrence Institute of Technology, Southfield	Burroughs E-101
	Michigan College of Mining and Technology, Houghton	Bendix G-15D
	Michigan State University, East Lansing	MYSTIC, 1 AS type, (1956)
	University of Detroit, Detroit	Burroughs E-102, (1956); IBM 1620, (1961)
	University of Michigan, Ann Arbor	IBM 704, (1959); IBM 709, (1960)
	Wayne State University, Detroit	IBM 650 RAMAC
Minnesota		
	Carleton College, Northfield	IBM 610, (1959)
	St. Olaf College, Northfield	IBM 610 (Jointly with Carleton College)
	University of Minnesota, Minneapolis	UNIVAC 1103, (1958)
Mississippi		
	Mississippi Southern College, Hattiesburg	Have on order RPC 4,000
	Mississippi State University, State College	IBM 650, (1958)
	University of Mississippi, University	IBM 650, (1958)
Missouri		
	Drury College, Springfield	LGP-30, (1959)
	Lincoln University, Jefferson City	IBM 1620, (1961)
	St. Louis University, St. Louis	IBM 610; IBM 1620, (1961)
	University of Missouri, Columbia	Burroughs 205, (1960)
	Washington University, St. Louis	IBM 650

Appendix C.--Continued

Montana		
	Montana State College, Bozeman	IBM 650
Nebraska		
	University of Nebraska, Lincoln	Burroughs 205, (1960)
New Hampshire		
	Dartmouth College, Hanover	LGP-30, (1959)
	University of New Hampshire, Durham	IBM 1620, (1961)
New Jersey		
	Newark College of Engineering, Newark	IBM 1620 being acquired
	Princeton University, Princeton	IBM 650; IBM 7090 on order
	Rutgers The State University, New Brunswick	IBM 650, (1957)
	Stevens Institute of Technology, Hoboken	IBM 1620 System, (1961)
New Mexico		
	University of New Mexico, Albuquerque	CRC 102-A, (1957); MANIAC I from Los Alamos (Not yet operative)
New York		
	City College, New York	LGP-30, (1960)
	Clarkson Institute of Technology, Potsdam	IBM 1620, (1961)
	Columbia University, New York	IBM 650, (1954); IBM 650, (1958); IBM 1620, (1961)
	Cornell University, Ithaca	Burroughs 220, (1959)
	Fordham University, New York	Bendix G-15, (1959)
	New York University, New York	IBM 704
	Polytechnic Institute of Brooklyn, Brooklyn	IBM 650
	Pratt Institute, Brooklyn	IBM 1620, (1961)
	Rensselaer Polytechnic Institute, Troy	IBM 650, (1958)
	Syracuse University, Syracuse	IBM 650, (1959)
	University of Rochester, Rochester	IBM 650
North Carolina		
	Duke University, Durham	IBM 650-653, being replaced by IBM 7070
	University of North Carolina, State College, Raleigh	IBM 650, (1956)
	University of North Carolina, Chapel Hill	UNIVAC 1105, (1959)
Ohio		
	Case Institute of Technology, Cleveland	UNIVAC I, (1958); Burroughs 220, (1960)
	Fenn College, Cleveland	Burroughs 205, (1960)
	John Carroll University, Cleveland	LGP 30-66, (1960)
	Miami University, Oxford	IBM 650
	Ohio State University, Columbus	IBM 704, (1958)
	Ohio University, Athens	LGP-30
	University of Cincinnati, Cincinnati	IBM 650, (1958)
	University of Dayton, Dayton	National 304; Burroughs 205; Burroughs 220
	Western Reserve University, Cleveland	G. E. 225, (1961)
Oklahoma		
	Oklahoma State University, Stillwater	IBM 650
	University of Oklahoma, Norman	IBM 650
Oregon		
	Oregon State University, Corvallis	ALWAC III E, (1957); IBM 1620, (1961)
	University of Oregon, Eugene	IBM 1620
Pennsylvania		
	Bucknell University, Lewisburg	Burroughs E-101, (1958); IBM 1620, (1961)
	Carnegie Institute of Technology, Pittsburgh	IBM 650, (1957)
	Drexel Institute of Technology, Philadelphia	IBM 650
	Lafayette College, Easton	IBM 607
	Lehigh University, Bethlehem	LGP-30, (1957)
	Pennsylvania State University, University Park	IBM System 650 RAMAC, (1959)
	Temple University, Philadelphia	IBM 650
	University of Pennsylvania, Philadelphia	UNIVAC I
	University of Pittsburgh, Pittsburgh	IBM 7070
	Villanova University, Villanova	IBM 1620, (1961)
Puerto Rico		
	University of Puerto Rico, Mayaguez	IBM 650, (1958)

Appendix C.--Continued

Rhode Island		
	Brown University, Providence	IBM 7070 System, (1960)
	University of Rhode Island, Kingston	IBM 610
South Carolina		
	Clemson College, Clemson	RPC-4,000
	University of South Carolina, Columbia	LGP-30, (1959)
Tennessee		
	Christian Brothers College, Memphis	IBM 1620 on order
	Tennessee Polytechnic Institute, Cookeville	IBM 1620
	University of Tennessee, Knoxville	IBM 1620, (1961)
	Vanderbilt University, Nashville	IBM 650, (1959)
Texas		
	Agricultural and Mechanical College of Texas, College Station	IBM 650, (1956); IBM 709, (1961)
	Howard Payne College, Brownwood	LGP-30, (1960)
	Lamar State College of Technology, Beaumont	LGP-30, (1958)
	Rice University, Houston	A computer built by Rice University and similar to MANIAC II; LGP-30
	Southern Methodist University, Dallas	UNIVAC Scientific 1103; UNIVAC Solid State 90; UNIVAC 120
	Texas Technological College, Lubbock	CRC 102-A (1959); Litton 20-40, (1960); IBM 1620, (Dec. 1961, tentative)
	Texas Western College, El Paso	Bendix G-15-J
	Trinity University, San Antonio	LPG-30
	University of Houston, Houston	IBM 650
	University of Texas, Austin	Control Data Corporation 1604, (1961); Control Data Corporation 160, (1961)
Utah		
	Brigham Young University, Provo	IBM 650, (1958)
	University of Utah, Salt Lake City	Burroughs 205
Vermont		
	University of Vermont, Burlington	IBM 1620, (1961)
Virginia		
	University of Virginia, Charlottesville	Burroughs 205, (1960)
	Virginia Polytechnic Institute, Blacksburg	IBM 650, (1958)
Washington		
	University of Washington, Seattle	IBM 709, (1960)
	Washington State University, Pullman	IBM 650, (1956); IBM 709, expected in 1961
West Virginia		
	West Virginia University, Morgantown	IBM 610, (1958); IBM 650, (1960)
Wisconsin		
	Marquette University, Milwaukee	IBM 650, (1958); plan to change to IBM 1620 in September, 1961
	University of Wisconsin, Madison	Control Data Corporation 1604, (1961); 3 IBM 1620, (1961)
Wyoming		
	University of Wyoming, Laramie	Bendix G-15D

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